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NEIGHBOURHOOD PLANNING: REMINISCENCE TOWARDS LIVEABLE COMMUNITIES

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Background

Urbanisation remains a topical discussion across the globe. According to the United Nations (2022), 68% of the world's population will be absorbed in urban areas by 2050. The envisaged rapid urbanisation in cities by 2050 is believed to be accompanied by various planning problems, which include accelerated climate change, urban slums, urban sprawl, poor sanitation, inadequate infrastructure, overcrowding, housing deficiency and transportation issues. To mitigate these planning problems, the role of effective urban planning cannot be overemphasised. Urban planning provides a pathway for overcoming the various challenges posed by urbanisation both in the present and in the future.

Urban planning is the process of guiding and directing land use for physical development to ensure a high quality of life and well-being of residents through the improvement of infrastructures and facilities, optimal economic development, and efficient operations and services (Bibri, 2018). Also, urban planning plays a significant role in actualising the Sustainable Development Goals (SDGs), particularly SDG 11, which seeks to make human settlement inclusive and sustainable (RELX, 2024). This implies that with efficient urban planning, access to a high quality of life for all city dwellers can be ensured amidst the present and forecast rapid urbanisation that would be experienced by cities of the world.

Planning as an ancient, multi-sectoral, and multidisciplinary discipline that is focused on the sustainable functioning and arrangement of space cannot be over-emphasized. As a discipline that is influenced by human habits, actions, policies and professional practices, planning (whether traditional or modern) is perceptual and suggests the role of humans in shaping settlements. Recognising this, the writing of Jagannath (2019) drawing on Clarence Perry neighbourhood ideology suggests that the need for planning is to be considered along a micro-level.

The liveability of workplace and place of resident emerged from the view that NP was both a response to placelessness (along the micro planning unit of space) and response to the degenerated social and environmental conditions that emerged out of the industrial revolution. Neighbourhood planning according to Parker (2012) allows for a community based radical strategy to emerging spatial problem. The writer documented that neighbourhood planning provides a room for the merging of formal (government and agencies) ideas with the local or informal (community resident), such that a cooperation is able to achieve an inclusive neighbourhood defined solution to identified problems. Recognising this, Bradley (2018) wrote that where development policy may privilege the supposed objectivity of technocratic rationalism, participation brings other ways of knowing and different types of evidence and methods of evidence gathering to the understanding of place (p.2). He further wrote that participatory planning practice has been seen as a touchstone for the ability of technocratic knowledge to accommodate lay perspectives of lived space. The incorporation of place-based

knowledge in development planning becomes integral to the epistemology through which abstract space is produced (p.24).

In this special issue, the diverse nature of planning (with focus on urban and neighbourhoods) and environmental problems were addressed. The authors in the special issue provided a multi- and interdisciplinary approach to understanding planning and in fact neighbourhood planning as a tool to managing and achieving liveability amidst rapid urbanisation.

In this special issue, from the twenty-one submissions and proposals, only thirteen were considered for publication. All the manuscript underwent a two expert blind review, plagiarism check and editorial reviews. The focus on the articles accepted for publication drew on local context to planning and responding wicked problems within local areas and the process of adopting immediate built-environment principles as captured in neighbourhood planning to managing these challenges that limits communal liveability. The importance of local context and 'neighbourhood-ness' of research draws on the position of Lee et al. (2022), that neighbourhood planning remains an under-utilised ideology, approach, and process of achieving community liveability.

This issue, as presented in the section below, provides a critical eye and/or perception on the inter- and multidisciplinary prisms of neighbourhood planning as a sustainable approach to achieving liveable communities.

Knowledge Offered and Contribution

In assessing floods in the coastal neighbourhood of Kosofe, Local Government Area of Lagos, Nigeria, Ajijola et al. (2023) examined the dimensions of neighbourhood characteristics that influence flood susceptibility. Spatial configuration and amenities were the two dimensions of neighbourhood characteristics identified in Kosofe. The study highlighted spatial configurations were, natural recreational areas, stormwater drainage facilities, domestic waste disposal facilities, water supply, roads and streets networks, floodwall/ barrier, flood retention ponds/ gardens and flood warning systems. The amenities dimensions examined were health care facilities, educational facilities, adequate power supply, space for social and religious activities, shopping facilities, and pedestrian walkways. This study revealed that the factors that significantly influence flood susceptibility within Kosofe were embedded within its spatial configuration. Thus, they state the importance of having appropriate physical planning measures to minimise flood susceptibility and enhance resilience in coastal neighbourhoods.

In the study by Ngcobo et al. (2023) on the Partnership and coalition efforts for Community-Based Research Towards a Liveable Urban and Rural Settlement in Kwazulu-Natal, South Africa. The Authors investigated the role community partnerships and coalitions played in the complex and ever-changing dynamics of communities in KwaZulu-Natal, South Africa. The theory of Community Coalition Action was the basis for the study, which emphasises the need to integrate community voices in decision-making processes regarding issues affecting their lives. The different types of partnerships required for successful community planning and effective partnerships in urban and rural communities were highlighted in the study. Ngcobo et al. (2023) further give an insight into how partnership and coalition efforts are necessary in community-based research. The relevance of Ngcobo et al. (2023) submission is supported by position that planning should be an open-ended process guided by the citizen (Talen, 2019) that provides a sense of community where people could interact, contribute to solving problems, and socialize.

Using the remote Sensing and Geographical Information Systems tool, the depletion of the watershed of Eleyele Dam, Ibadan, Nigeria, was examined by Adejumo and Osunwale (2023). The study revealed that human activities such as fuelwood harvesting, indiscriminate waste dumping, sand excavation and housing construction accounted for the depletion of the watershed of Eleyele Dam.

The temporal analysis also shows that between 1987 and 2019, the water body of Eleyele Dam decreased from 1.6 km2 in 1987 to 1.3km in 2019. The study further shows an inverse relationship between urban expansion and loss of vegetation cover within the watershed. The approaches suggested to check the depletion of the watershed include perimeter fencing around the watershed and reestablishing a buffer zone in areas yet to be developed around the watershed.

Studies have reported on the unfolding, evolution and dynamics of planning as both practice and discipline. This evolving planning ideals, process, learning process, and approach (Pickett et al., 2004; Mrduljaš & Kulić, 2012; Burayidi, 2015; Gurran & Bramley, 2017; Popoola et al., 2022) suggest that built-environment training and education must work side-by-side with practice. This the author mentioned that the neighbourhood planning alteration(s) has produced a range of neighbourhood planning forms that are reflected through the interplay of institutionalised agency, local conditions, policy iterations and varied community-local scale dynamics.

Towards recognising and understanding the fluidity and adaptability of achieving liveable communities, built-environment education remains imperative. Govender and Cloete (2023) article which is titled: Towards a Sustainable Urban Community at the Point of Development in Durban, explored the symbiotic relationship between architectural education and urban design of The Point Precinct in Durban, eThekwini, KwaZulu-Natal, South Africa. The benefits of adopting a bottom-up approach toward creating sustainable urban neighbourhoods were also emphasised in the study. The combined theories of sustainability, urban resilience, and the "Right to the City" were the basis for this study. Data for this study was collected using a combination of spatial mapping at various levels, observations, and transect walks. The study by Govender and Cloete (2023) provides urban planning and architectural students with the necessary skills to create a bottom-up approach to sustainable urban design reflecting the neighbourhood's needs of the community.

Other studies titled Liveable Communities: A Case Study of Availability, Proximity, and the Quality of Critical Infrastructure in Colombo, Sri Lanka (Tennakoon & Kulatunga, 2023) and assessment of educational facilities in Osogbo metropolis, Nigeria (Ogundahunsi et al., 2023), both studies examined how critical infrastructure contributes to the liveability of Colombo, Sri Lanka and Osogbo, Nigeria. The study explained that the availability of important services, such as education, healthcare, transportation, energy, and communication, is significant in building a liveable community. Tennakoon & Kulatunga (2023) opined that the little consideration given to quality (reliability, timeliness, safety and security, accessibility, efficiency, effectiveness, and customer satisfaction) and proximity (residential, workplace, transportation, and emergency services) was consequential to the failure of achieving liveability goals in developing countries. Ogundahunsi et al. (2023) evidence suggests that location of neighbourhood to reside is influenced by availability and access to educational facilities. The view was that distance to a facility within the context of neighbourhood planning contribute to livability and support in managing infrastructure exclusion among some residents and neighbourhood.

The studies further explains that there is little or no consideration of the community's perception of providing critical infrastructure in developing countries. The inability of stakeholders to consider the community's perception of providing infrastructure is believed to hinder the liveability measures of urban development in developing countries. This position aligns with Yuille (2020) view that neighbourhood planning is performative: it does not merely give powers to an already-existing community, but produces new actors, new collective identities, which are constituted both materially and socially (p.1382). This explains that neighbourhood planning over the years continues to change in response to expected project or planning outcomes. This is because planning as a discipline and practice is not static and continues to change based on places, time, and scenario/circumstances. Thus, communities must be involved in the making and reshaping of planning elements in their space.

Using the quantitative research design, Ajayi et al. (2023) examined the impacts of drainage infrastructure conditions on the residents of Mowe in Ogun State, Nigeria. Based on the study's findings, drainage infrastructure was believed to have a significant impact on the living conditions of the residents of Mowe. The primary drainage examined in this study was the surface drainage system, mainly constructed with the sandcrete blocks. The study emphasises the need for policy planning geared at mitigating flooding to improve the quality of the environment in Mowe.

Govender and Shaikjee (2023) stated categorically that top-down development approaches often fail to promote sustainable urban development. In their study on an architectural approach to neighbourhood Design in the informal settlement in Durban, the role of architecture in responding to the needs of informal dwellers was explored as a tool to empower slum dwellers. The study revealed the dynamics of informal settlement can only be understood by having a firsthand experience of walking around the community and learning from the informal dwellers. Walking around the informal community and learning from its dwellers will help map the community's needs and give more insights into the threats inherent in informal settlements (Govender and Shaikjee, 2023). The study expressed that understanding the needs and threats in informal settlements is a strategy to achieve a sustainable neighbourhood design. The combined theories of culture, insurgency, and the "Right to the City" served as the basis for this study.

Owoeye et al. (2023) employed the quantitative method to evaluate the impact of service delivery on the welfare of IDPs residing in the Federal Capital Territory (FCT), Abuja. The evaluation of the service delivery on the well-being of the IDPs in the FCT was carried out by assessing the socio-economic attributes of the IDPs, scrutinising the types and efficacy of service delivery within the IDP camps, and appraising the consequences of service delivery on the well-being of the IDPs in the FCT. The study revealed the extent of deprivation endured in terms of essential amenities such as shelter, proper sanitation, reliable electricity, potable water, and adequate healthcare provisions within the IDPs in the FCT. The study by Owoeye et al. thus recommends comprehensive planning measures intending to enhance the well-being and overall quality of life of IDPs in the FCT.

The land surface temperature (LST) of the Suburban settlements of Inisa and its environs in Osun State, Nigeria, was estimated by Ojolowo et al. (2023) using the archival data of Landsat satellite imageries. The study by Ojolowo et al. (2023) explains the efficacy of remotely sensing data in explaining the variability of LST and Land-use Land cover (LULC). The analysis shows that climatic phenomena can inform future urban planning and liveable urban areas amidst climate change.

Jimoh and Famewo (2023) examined the socio-economic effects of Orisumbare sawmill industry on the residents of Ikire, Irewole local government area of Osun state. In examining the socio-economic characteristics of the sawmill, the socio-economic characteristics of the respondents and the impact of the sawmill on the residents of Ikire Irewole were assessed. The sawmill activities in the study area had a significant effect on the residents' socio-economic lives, and the sawmills' impacts on the residents were perceived in terms of environmentally induced ailment.

Fitriyani et al. (2023) explain that the local wisdom that exists within a community plays a crucial role in influencing the thinking and conduct of the community. The Fitriyani et al. (2023) study assesses the components of water awareness within the Irung-Irung tradition practised by the people of Cihideung Village in the West Bandung Regency. Data was collected for the study using the qualitative research design. The findings of the study shows that element of water awareness in the Irung-Irung tradition hinges on gratitude to God for a spring that never subsides, respect for the spirits of the ancestors, and the strong bonds of brotherhood among the residents of Cihideung Village. The values in the Irung-Irung tradition are essential to actualising SDG 6 in Cihideung Village.

The exploratory research by Medayese et al. (2023) employed the partial least square using SmartPLS to evaluate the Evolving Hangwurian City Development model through the lens of the North-Central Nigeria. The position of Medayese et al. (2023) was the need for an ideological shift at understanding city development. The authors attempted to for constructs and better explains sustainable development with the local area. The constructs were the underlying principles that led to the emergence of Hangwurian city development model. The essentiality of this article buttress on the need for a sustainable and liveable approach that supports localism and regional public interest and indicators in planning process.

One key evidence from the special issue is the role of local people in managing and responding to local planning challenges. This special issue has succeeded in advocating for need to revisit neighbourhood planning process and procedure towards liveable communities.

Evidence and Commentary of Practice and Professional Experience to Neighbourhood Planning for Liveable Community: The Conclusion

All the articles presented in this Issue point towards one direction- it is the communities that make the city. The character identified with a city is the summation of the character of and experiences in the various neighbourhoods and communities. This is in tandem with the position of LaForest (2023) that it is worthwhile "…to remember that the building blocks of these metropolises were, and still are small communities…" It is therefore incontestable that efforts to plan or reinvigorate a city should start at the community level with due attention paid to the individuals especially what they think of their community. Planning or renewal should start with intervention at community levels.

The roles of communities in the attainment of SDG 11, especially Targets 11.1, 11.5 and 11.9 cannot be overlooked because the strength of the community help to define the level of success or decline in urban areas (Rudlin and Falk, 1999) The influence of and concern for governance had been a common thread in the various articles in this Issue of the journal. Lack of inclusivity in determining the intervention needed for communities by a lack of bottom-top approach could be isolated to explain the limited success of identifying the problems and priorities of the community. It is therefore not surprising that to physically and socially define their boundaries communities are being defined even within larger communities. Developers and investors have taken advantage of this urge to be in "control" through the development and acceptance of what had become known as "gated communities" where communal efforts are pulled together to provide infrastructural facilities especially security of lives and properties.

However, because of the various variables of culture and environment readers are urged to read of the articles for better grasp of the contributions and challenges of communities in achieving live able environment. However, the inclusion of the people is paramount as a Nigerian proverb says "You cannot shave a man's head in his absence.

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TOWARDS A SUSTAINABLE URBAN COMMUNITY AT THE POINT DEVELOPMENT IN DURBAN

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ABSTRACT

Urban design is the art and method of shaping cities and communities; it plays a pivotal role in creating sustainable, liveable environments that cater to the diverse needs of residents. As urbanization continues to shape our world, integrating architectural education with a bottom-up approach to urban design becomes increasingly imperative. This paper explores the symbiotic relationship between architectural education and urban design, emphasizing the benefits of adopting a bottom-up approach toward creating sustainable urban neighbourhoods. This research aims to explore and understand the role of architectural education and urban design in developing a sustainable urban neighbourhoods in the case study of The Point Precinct in Durban, eThekwini, KZN. A bottom-up approach to urban design places communities at the heart of decision-making processes. Rather than relying solely on top-down, expert-driven solutions, this approach recognizes residents knowledge, aspirations, and needs when aligned with a bottom-up perspective, Architectural education teaches students to be active listeners, keen observers, and empathetic designers. This approach equips future architects with the skills to engage with communities, fostering a sense of ownership and co-creation in urban projects. The theoretical framework combines the concepts of sustainability, urban resilience, and the “right to the city". The methodology included data collection using a combination of spatial mapping at various levels, observations, and transect walks. By applying a mixed-methods approach, this study proposes a range of techniques drawn from multiple disciplines to deal with spaces needed to develop a sustainable urban neighbourhoods, allowing students to learn skills needed to create a bottom-up approach to urban design. The findings indicate how the approach will enable students to produce architectural designs that reflect the neighbourhood’s needs.

Keywords: Sustainability; Insurgency; African cities; Circular economies; Resilient cities

1. INTRODUCTION

Urban design models guided the planning of most cities. Ernest Burgess concentric zone model, Homer Hoyts sector model, and Chauncy Harris and Edward Ullmans multiple nuclei models were used to plan for complex issues facing cities (McCarthy &Smit, 1984). Good cities should be designed to optimize efficiency by responding to citizens needs by creating efficient and affordable transport systems, livelihood opportunities, inclusive spaces, and good governance and planning structures.

Various international planning models guided the planning of the city of Durban. However, these planning models served as tools to enforce segregation and assert power. This was observed through the Apartheid city model implemented in the 1950s, whose complexities are still being dealt with today. These issues cannot be solved with international models and require a more site-specific,

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community-oriented design. The city of Durban now faces an insurgency challenge, due to unresponsive planning and infrastructure.

Durban was initially planned on the Burgess concentric zone model. This model was based on a 1925 case study of the Chicago CBD, whereby the CBD was conceived as the nucleus of the city with high land value and high levels of transport infrastructure (McCarthy & Smit, 1984). Durban has moved away from this model, as seen by the lack of investments in the CBD and the developments occurring to the north of the city in places such as Umhlanga and Ballito.

The lack of investment in the city centre has resulted in urban decay and lost and forgotten spaces within the city. These spaces are often susceptible to insurgencies in the form of hijacked buildings or homeless people living on the streets.

The Point Precinct development precinct is located on the east coast of South Africa, in the Province of KwaZulu-Natal in the eThekwini Municipality, and was initially part of the port and predominantly state-owned land. The inner city is located at the entrance of the harbour, which is the busiest port in Africa, comprising the Ushaka Marine World, the Point Waterfront development, and part of the beachfront stretching from Mahatma Gandhi Road down to Shepstone Street (Dwamena, 2015). The Point area was subsequently excluded from redevelopment, contributing to its decay and dilapidation, turning it into a well-known red-light district (Maharaj & Ramballi, 1998).

Factors influencing the urban sustainability of an area, such as urban decay, environmental degradation, political strife, and economic decline, are not characteristics of urbanisation but rather the results of poor governance and planning (rode & Burdett, 2018).

The Durban Infrastructural Development Trust (DIDT) established the Point Redevelopment Programme (PRP) in 1991 as a protocol among key stakeholders to redevelop the Point Precinct. Some of the principles in the protocol involved community upliftment, creating holistic links to the greater city, and including public participation (Point Development Protocol 1993).

Understanding key concepts such as adaptive reuse, urban upgrading, urban resilience, and new urbanism can solve Point Precinct's social, economic, cultural, and political challenges. The Point Precinct uses the Point Development Protocol as a guiding framework to address upgrading and development. However, this protocol ignores input from communities living in the precinct, with little or no upgrades benefiting them. The result is developments focusing on the economically advantaged, leaving most of the Point Precinct in a state of despair. A new approach is needed to address the complex issues facing the Point Precinct and build resilience and sustainability in the precinct.

This study follows a holistic design approach using architecture as its primary lens to find a solution at the Point Precinct. Architectural solutions are tested to conform to their viability using co-design, co-production, adaptive reuse, edge and node analysis, and community-oriented design strategies. This allows architecture to respond to the community's needs and aid in creating a more resilient and sustainable neighbourhood.

This study aims to use a bottom-up approach to studio design to analyse what lost space exists within the selected study area and design solutions on how it can be adapted to serve its community better. Poor design choices or strict zoning regulations can result in lost spaces in-between, on top of, and under buildings. This study allowed students to investigate and capture lost space and test solutions that contribute towards creating resilience and sustainable neighbourhoods. We used various mapping methods, including analysis at different urban scales, transect walks, sketches, and observations, to capture lost spaces. These tools aided students in comprehending the study and enhanced the creation of an urban design through a bottom-up approach.

The paper presents a literature review of the concepts of lost space and insurgency, followed by resilience and insurgency. The literature further considers the bottom-up pedagogic approach to

architectural design studios. We present a case study where we observed this approach in teaching the Bachelor of Architecture Honours program at UKZN. The study shows the studio methodology of urban analysis and urban design and evaluates the outcomes of the students' urban proposal for the Point Precinct. The student's work is analysed through the conceptual framework and discussed in parallel with recent developer proposals for the same precinct. The findings indicate that the bottom-up studio approach enables a deeper understanding of the needs of communities, leading to the development of design approaches that support the development of sustainable communities and meet the needs of neighbourhoods.

2. LITERATURE STUDY

2.1. Lost Space and Insurgency

South Africa's history is formed by resistance and struggle movements as a reaction to apartheid planning and colonization. The right to the city and people's resilience helped shape the diverse South Africa we live in today.

Historically, insurgency refers to violent armed rebellion by smaller groups in uprisings against state authority. However, insurgency is a new challenge facing the built environment and has different meanings. Lefebvre (1968) defines insurgency as 'the right to the city', a concept rooted in social theories. Architects and planners failed to foresee insurgency as an issue facing cities, and as a result, the line between the formal and informal becomes blurred in cities today.

King (2022) states that insurgency occurs during periods of mass urbanisation; when economic and social factors influence the mass influx of people to cities, cities become hosts of space for insurgent citizenship. Holston, (2008) further reiterates that insurgent citizens a form of agency by which marginalized and excluded citizens manage to destabilize entrenched modes of discrimination and domination through practices that reshape urban landscapes, opening the way for new claims and political voice (Latta, 2014). Nel & Du Plessis (2004) define insurgency as change and how systems respond to change. Mitchell (2003) in his book 'The Right to the City: Social Justice and the Fight for Public Space,' draws on the works of Henry Lefebvre and Raymond Williams to relook at cities and their spaces as to who has a right to use them and how they are defined (Reynolds, 2004). (Lefebvre, 1968) argues for a change in how cities are governed; spaces should belong to urban dwellers, and urban dwellers should be in control and define public space for their own uses (Purcell, 2002).

Lefebvre's production of space introduces three concepts of space: perceived, conceived, and lived, to understand the complexity and multifaceted nature of social space. Perceived spaces refer to physical and sensory experiences of space, this includes buildings, streets, and landscapes. Conceived space involves the mental and abstract representations of space. Maps, urban plans, and architectural designs, reflecting the intentional organization of the environment, reflect conceived space. Lived space is the everyday lived experience of individuals within the spatial environment. It is a space shaped by practices and the people inhabiting it (Lefebvre, 1991).

Lefebvre's definition of space differs from that of architects and planners, as space is related to social relationships connected to space and not just the conceived relationship of space. Therefore, Lefebvre defines space as a product of social relations and a social-political product (Babere, 2015).

Lefebvre's definition of space intertwines social constructs and structural constructions, defining spaces not as neutral containers but as social constructs. Therefore, by recognizing the interplay between perceived, conceived, and lived spaces, urban planners and architects can develop more holistic and responsive approaches to understanding and shaping the built environment. Maziviero (2016) relates this socio-constructed space to tactical urbanism in describing the transformation process of Times Square in New York City from vehicular dominance to a public place.

Architecture and urban design contribute towards insurgency, lost space, and the right to the city. Architects and planners design spaces based on their own ideals and concepts of what citizens should use; this is a top-down approach to urban design. Often, how the space is conceived is not how it is perceived or used; examples can be found in lost and abandoned buildings, in spaces that cannot accommodate and change to the user's needs. Once built, architecture and urban spaces allow urban dwellers to interact and live in them. Citizens have used public spaces like Tiananmen Square, Tahir Square, Pearl Roundabout, and Zuccotti Park to protest and voice their opinions on political issues. The architect has failed to realize how politics, democracy, and the right to a city can transform space and its meaning.

In Durban, due to apartheid city planning, the urban poor and marginalized in society are often situated far from job opportunities and the CBD. As a result, lost, neglected, and abandoned spaces are often claimed by the marginalized in the form of informal settlements, squatting, or illegally occupying buildings to be closer to economic activities, transport, and services. In his book 'Rebel Cities', Harvey (2012) argues that insurgency is a solid revolution to take the city back from the elite. A restructuring of the apartheid city needs to occur, whereby equal distribution of land and services can occur to address the inequalities of the apartheid city model.

Architecture and the built environment have been tied to power relations throughout time; in the past, architecture was used as a symbol to enact status, wealth, or dominance over nations. Today, citizens can use it as a means to claim the right to the city or as a space to protest for revolution and resistance.

2.2. Resilience and Sustainability

Sustainability can be defined as meeting the needs of the present without compromising the ability of future generations to meet their own needs. Sustainability can be viewed as three sub-categories, all linking to form a sustainable urban environment. Social sustainability emphasizes the well-being of communities and individuals by promoting equality, inclusivity, and social cohesion. Social sustainability can also be achieved in marginalized communities by empowering them, promoting social justice, and building resilience. Environmental sustainability involves responsible resource management, conservation, and mitigation of climate change impacts. By utilizing technology and good building practices, societies can minimize their ecological footprint on the environment and reuse waste, creating a circular economy. Economic sustainability involves creating inclusive economic opportunities, systems that support marginalized communities, good economic practices, and also empowering marginalized communities to address inequality challenges. Resilience complements sustainability by providing the capacity to bounce back from adversity and adapt to changing circumstances. This is particularly important in the face of global challenges such as pandemics, natural disasters, and economic downturns. Resilient systems are characterized by their ability to absorb shocks, recover quickly, and adapt to new circumstances. Flexible governance structures, robust infrastructure, effective risk management strategies, and community engagement can achieve this resilience.

Wikstrom (2013) argues that sustainability aims to put the world back into balance, while resilience looks for ways to manage an unbalanced world. Resilience is a crucial concept for operating sustainability, whereby sustainability combines social equity, economic viability, and ecological integrity (Pickett, et al., 2014). The above definitions of resilience and sustainability are intertwined to create sustainable urban environments.

Sustainability encompasses a wide range of initiatives, including prominent frameworks like the Sustainable Development Goals and the 100 Resilient Cities Initiative. The overarching goals of sustainability are centred on the interconnected realms of the economy, environment, and society (Ross, 2009). Examining the Earth's ecosystems, sustainability addresses heightened social and

economic hazards within cities due to escalated resource consumption, climate change, pressure on urban economic resources, and environmental degradation.

To establish sustainable environments, achieving a harmonious equilibrium among the present social, economic, and environmental requirements is crucial, all while safeguarding future generations' needs. From this perspective, sustainability is conceived as a collection of socio-ecological systems (SES), encompassing the interplay between biophysical and socio-economic elements or the amalgamation of social and technical components (Lankao, Gnatz, Wilhelmi & Hayden, 2016). Within these socio-ecological systems, the interaction between humans and ecosystems significantly influences the sustainability and resilience of the overall system. Socio-ecological paradigms entail recognizing how individuals, groups, and various stakeholders coexist and shape transactional relationships within interacting natural and semiotic systems.

The socio-ecological perspective emphasizes the ongoing interactions between various systems, with changes continuously occurring in both directions (Stokols & Lejano, 2013). This approach enables the comprehension of urban impacts and environmental responses, shedding light on the intricate relationship between humans and nature. We can apply the socio-ecological systems (SES) framework to elucidate the mutual interactions between humans and the environment. Insufficient understanding of these interactions has resulted in societal and environmental challenges such as food shortages, water scarcity, and land degradation. Therefore, establishing a sustainable system necessitates connecting social and ecological systems. Achieving sustainable ecological systems requires appropriately aligning social institutions and biophysical processes to yield desired outcomes (Fernandez, Gonzalez & Selma, 2021).

Climate change is one of the most significant factors affecting SES in urban and natural environments. The stress and adaptation affecting both environments indicate the need for a more effective response to mitigate climate change. An example of societal adaptation can be observed in weatherproofing/climate-proofing houses from wildfires and floods occurring more frequently in parts of the world. By placing houses on columns and building fire barriers around housing plots, societies respond to the extreme weather conditions affecting them today. All cities are now under threat from unpredictable weather patterns and disasters.

Coping strategies are not always effective in dealing with climate change; examples can be observed in people who borrow money to repair their homes after natural disasters. Rebuilding does not always constitute a positive response or show resilience if the disaster becomes more frequent. This is observed in informal settlements responding to fire threats; often, communities rebuild in the same spot and use the same construction methods as before the fire. In order to enhance resilience, it is crucial to consider a community-driven approach that employs innovative problem-solving techniques through transformative adaptation. Examples are working with communities to re-block the settlement plans, looking at the threats and vulnerabilities of the site and allowing homes to respond to this by climate-proofing structures, and responding to geographical threats near rivers, sinkholes, and fires. This form of rebuilding enables the community to become resilient and respond to threats, rather than repeating the same mistakes and replicating unsafe building practices.

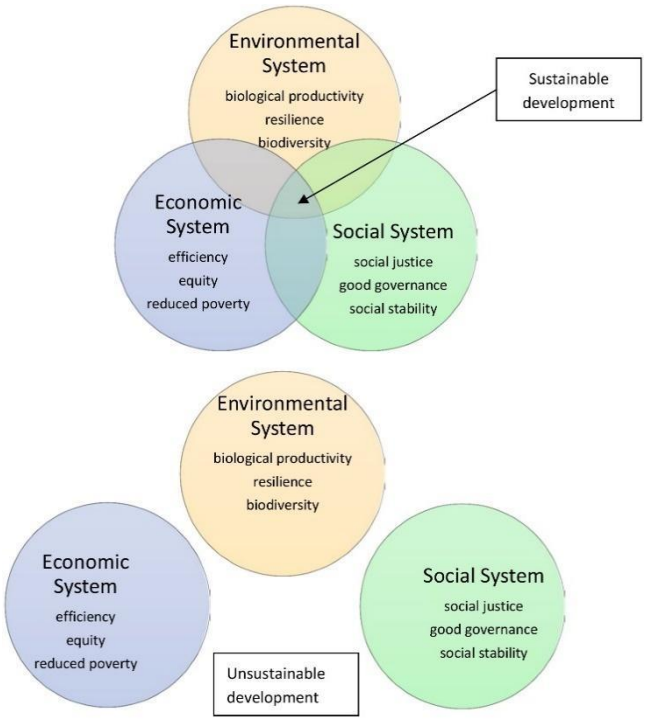

Figure 1 The Systems Approach to Sustainability, Showing a Sustainable and Unsustainable Development (Barbier & Burgess, 2017:4)

Figure 1 highlights steps to achieve sustainable development, and interconnectedness between the environmental (ecological), economic, and social systems. If one system is ignored in favour of the other two, the system does not reach sustainable development. Sustainable development can only be achieved by balancing the trade-offs among the various goals of the three systems (Barbier & Burgess, 2017).

2.3. A Bottom-up Approach to Architectural Design Studio's

The field of architectural plays a fundamental role in shaping the built environment of our cities. Traditionally, architectural education has been oriented towards a top-down approach, focusing on the design expertise of individual architects. The conventional design studio primarily revolves around the roles of the teacher and students, with learning occurring through periodic evaluations by an experienced designer. Students undergo assessments from a panel of practicing architects known as the jury, and the learning process involves designing individual projects; however, learning is limited to the group of experienced professionals in the studio (Pak, 2016). As we face complex urban challenges, there is a growing need to incorporate a bottom-up approach to urban design within architecture schools. Integrating this approach into architectural education can prepare future architects to create sustainable, inclusive, and community-driven urban spaces.

The bottom-up approach to urban design in architectural education revolves around instilling a mindset that prioritises community engagement, collaboration, and empathy. Some of the key components of this approach are:

- Community-Centered Learning: Architecture schools should encourage students to engage directly with communities, listening to their needs and aspirations. By involving the community in the design process, architects can better understand the unique context of a place and create more meaningful solutions.

- Interdisciplinary Collaboration: A bottom-up approach encourages architecture students to collaborate with students from other disciplines, such as urban planning, sociology, and environmental science. This fosters a holistic understanding of urban challenges and promotes innovative solutions.
- Local Knowledge Integration: Students should value local knowledge and expertise. Architecture schools can emphasise the importance of context-specific design solutions by working closely with communities and local practitioners.
- Empowerment and Ownership: Architectural education should empower students to work in partnership with communities rather than imposing preconceived designs. This approach fosters a sense of ownership and shared responsibility for the built environment.

Integrating community engagement and collaborative projects into architectural education allows students to gain practical experience, preparing them for the complexities of real-world urban design projects. A bottom-up approach encourages students to think creatively and adaptively to meet diverse community needs. This fosters innovative design solutions that are contextually relevant. Architects trained in a bottom-up approach are more likely to create sustainable and inclusive urban spaces. They consider design's social, environmental, and economic dimensions, leading to more resilient cities. Architecture students develop a strong sense of civic responsibility by working closely with communities. Their understanding of the impact of their designs on people's lives motivates them to create spaces that enhance quality of life.

3. METHODOLOGY

The case study is the student's urban analysis and urban design project based on the Point Precinct in Durban. The area studied is located between the harbour mouth and the CBD; the Point Development node encompasses the primary and secondary zones, as shown in Figure 2.

The urban degradation at the Point development stems from years of neglect and a lack of investment in the space. The revitalization occurs within the primary zone and has resulted in gentrification, with little or no development benefiting the existing communities.

Students were given a design brief with tasks assigned to investigate and research from a bottom-up approach. The ecological system merges the built and the unbuilt to face ecological emergencies such as water excess or loss, high crime rates, and the impact on community loss. This project investigates the community as part of a broader ecosystem influenced by geographical and cultural considerations.

The project focused on the user's perspective to investigate this part of the city. This was done knowing that the Point Precinct is part of Durban's larger 'city'. The user, the city, and the governance are not mutually exclusive, with each actor contributing towards creating a living organism and being interdependent on each other. Students were asked to address some of these parts in their investigation of the site and were expected to discover them through their exploration journey.

In the spirit of the UN-Habitat 2004 journal, it addressed whether'master planning is dead' and that we adopt a way forward. In this journal, the general view was that master planning is too rigid, top-down, and impossible to implement. They are unfeasible, take years to mobilize and don't engage local communities. The journal saw participatory planning as the way forward.

The ethical processes determined the scope of participatory research for the project. Due to the logical constraints of obtaining gatekeeper permissions from community leaders, direct engagements with community members could be included. However, we approached participatory planning by having

the following two sources: through students as a research community and through the range of data collection methods, including a transect walk through the precinct.

To assist in the process of data collection, the following prompts were given to students for their inquiries:

What is your understanding of the problem?

What are you doing about it?

What is this project's purpose (real value as opposed to use)?

Why are you doing this?

Who is it for?

How will it be achieved?

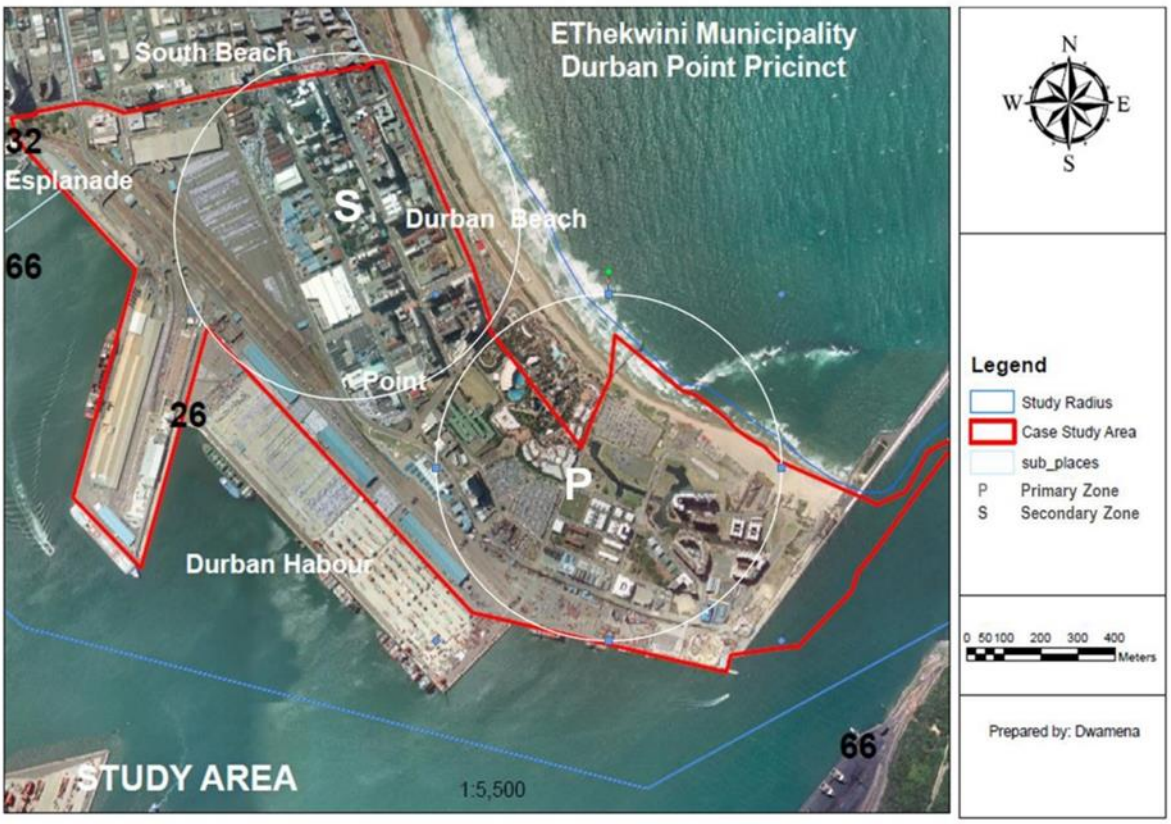

Figure 2 Map Showing the Primary and Secondary Zones of the Study Area (Dwamena, 2015:135)

Figure 2 indicates the primary zone for the study in relation to the secondary study area, which forms the broader context. The following methodology was applied in creating a bottom-up approach to urban neighbourhood design:

1) transect walk and site observations.

This process was carried out in groups of 4; each group consisted of 5 students. Students observed the study area and mapped street facades. They attempted to answer the questions put forth in brief and, at the same time, collected first-hand experiences of the study area, observing the community's uses of space (see Figure 3).

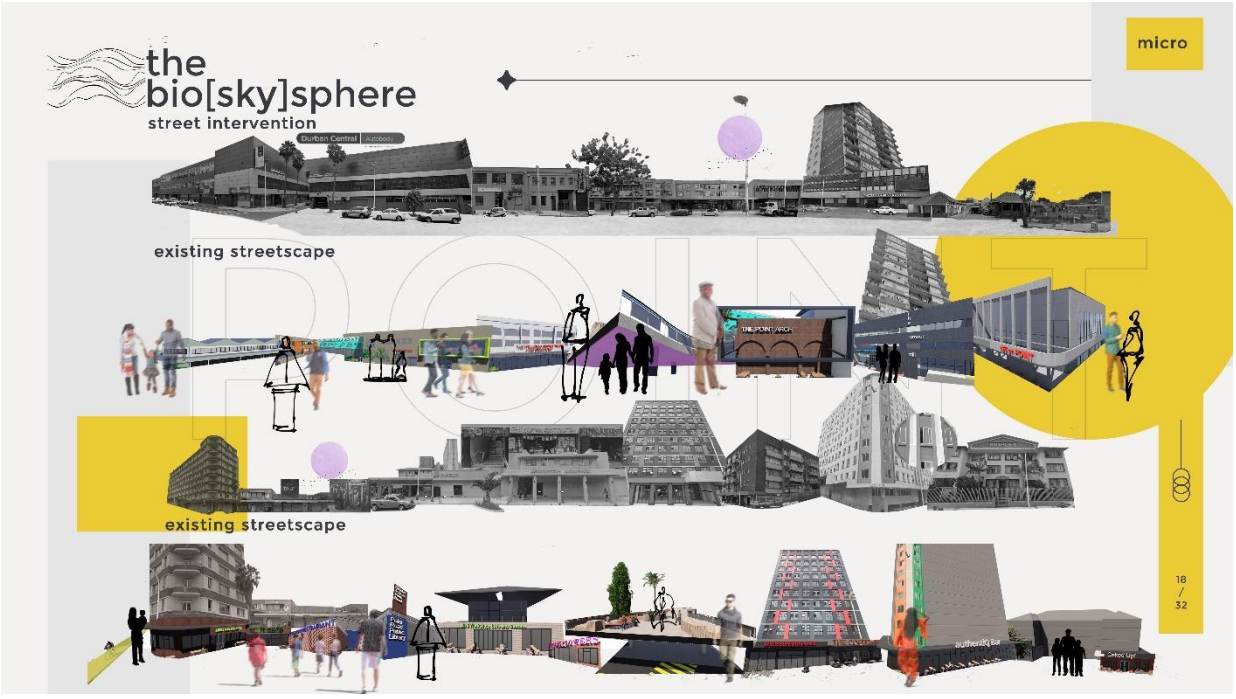

Figure 3 Student Mapping of Street Facades

2) Mapping at various scales

We conducted mapping at various scales, including macro, meso, and micro, to gain a comprehensive understanding of the study area and its context. This task was divided among groups and included (see Figure 4):

a. Urban analysis

b. Background/historical analysis

c. transport network systems

d. Mapping trade activities and formal businesses

e. Recent and current proposals

f. Linkages to the city

g. Theories applied in urban planning

h. Lost space analysis

Figure 4 Examples of Findings from Group Investigations and Critical Inquiry from Students

3) urban design proposal

Analyzing and understanding the data found, students then created design drivers that would respond to the community's needs and wants. This response considered interactions and observations with the existing community to create a sustainable urban environment that would empower the communities of Point Development. Students came up with an overall vision and concept derived from the site and their experiences with it.

Figure 5 Design Drivers and Vision Generated for the Community of the Point Development

As seen in Figure 5, a bottom-up approach to urban design offers a promising pathway to creating more sustainable, resilient, and inclusive cities. By allowing communities to actively participate in the planning and development of their neighbourhoods, this approach utilizes local knowledge and values to shape urban environments and respond to the needs and aspirations of the residents. While challenges exist, the potential benefits of sustainability, inclusivity, and community well-being make it a valuable and transformative approach to urban design in the 21st century.

4. RESULTS AND DISCUSSION

4.1. Socio-Spatial Analysis

The students' analysis of their urban design revealed the benefits of using a bottom-up approach to urban design. Bottom-up urban design promotes sustainability by incorporating local knowledge about natural resources, climate conditions, and environmental challenges. This approach often leads to more sustainable infrastructure and practices, like community gardens, green roofs, and renewable energy initiatives. Bottom-up urban design values cultural heritage and traditions, preserving the unique identity of neighbourhoods. This can include the revitalization of historic districts and the celebration of local art and culture.

The student's work starkly contrasts the urban design proposal by the eThekwini municipality and ROC Point (PTY) Ltd. This is a top-down approach, which would lead to gentrification of the Point precinct. The current urban design proposal aims to create unique and exclusive real-estate developments that link to the newly developed promenade extension to the rest of the Point

Development, further enhancing the primary zone of the Point Development. This development will see the commercialization of the Point Developments, creating a unique tourist link by developing a world-class waterfront development (see Figure 6).

Figure 6 The Current Masterplan by ROC Point (PTY) Ltd (https://www.durbanpoint.co.za/master-plan/)

The internationalization of investors brings a globalized image to Point Development, ignoring the local culture and context of Durban. Figure 7 below shows conceptually generated computer images devoid of Point Development's local culture and context, overlooking the area's rich history. This architectural language is not site-specific and can fit anywhere in the world.

Figure 7 Globalised Architecture Envisioned at the New Point Development (www.DurbanPoint.co.za)

The patterns observed in prior suggestions and existing development plans exhibit notable similarities. Mixed-income neighbourhoods have received minimal attention, and every proposal exhibits some level of exclusivity. Furthermore, all proposals overlook or underestimate the importance of establishing connections to the Durban Central Business District (CBD) as a crucial element in linking the Point to the broader city. The proposals' disregard for the existing communities

residing in the Point area is particularly troubling. In contrast, the students bottom-up approach creates a much more inclusive urban design approach that fosters neighbourhood development and planning at the centre of the design (see Figure 8 and Figure 9).

Figure 8 Student Approach Showing Amenities and Services that Respond to the Community Needs Existing Buildings are also Reused to Retain Cultural Heritage and Identity

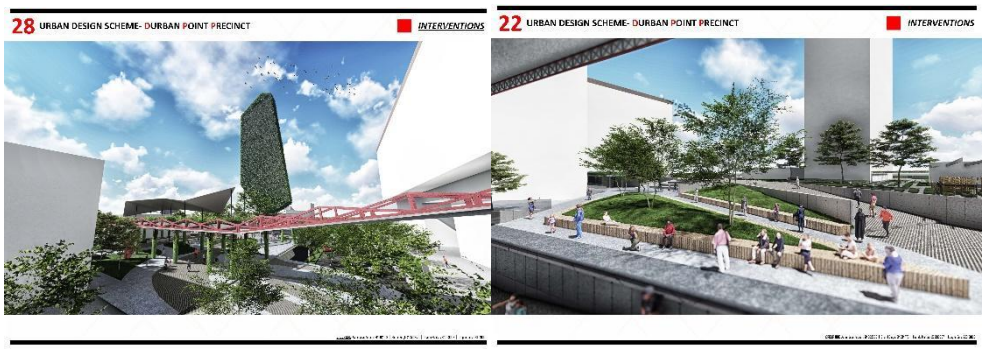

Figure 9 Student Images Show a much Human-centred Approach to Design. The Design Reflects Inclusivity and Walkability, therefore Catering to all Income Groups

Neighbourhoods are the building blocks of our cities and communities, serving as the spaces where people live, work, and interact daily. The traditional top-down approach to neighbourhood development has often led to disconnected and impersonal spaces, as seen in the developer images in Figures 6 and 7. In contrast, a bottom-up approach to creating neighbourhoods, which emphasizes community engagement, local knowledge, and grassroots initiatives, offers numerous benefits that contribute to more vibrant, sustainable, and inclusive communities. Allowing students to design from a bottom-up approach will enable them to develop as designers, using communities as co-investigators and knowledge contributors. This allows architecture to be an inclusive change element for commuters, reflecting and responding to their needs and wants.

5. CONCLUSION

This research aimed to explore and understand the role of architectural education and urban design in developing a sustainable urban neighbourhood in the case study of The Point Precinct in Durban, eThekwini, KZN. By empowering students with alternative methodologies for data collection, the design studio changes to enable students to be contributors to knowledge.

The level of community engagement does impact the depth of understanding. As an academic project, the engagement requires careful negotiation and following ethical protocol. The case study presented in this paper did not include ethical permissions to engage directly with community members as participants, limiting the depth of understanding. A further limitation relates to the danger of creating expectations in a community and how this impacts the research process, as no tangible outcome is possible. However, the pedagogic approach to the urban project affects their growth as future architects and urban designers who instill a sensitivity to user needs. A further benefit is the dissemination of the knowledge generated through publications and exhibitions, creating a dialogue towards bottom-up approaches in practice.

However, interdisciplinary collaboration between the university, communities, NGOs, the municipality, and developers is required to enable a real impact on neighbourhoods and develop sustainable communities. Without a move towards more participation and bottom-up design implementation, the extent of gentrification will lead to further insurgencies, lost space, and emerging dilapidation, as currently found in the Point of Durban, South Africa.

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ANALYSIS OF THE EFFECTS OF SERVICE DELIVERY ON THE WELLBEING OF THE INTERNALLY DISPLACED PERSON (IDPS) IN THE FEDERAL CAPITAL TERRITORY (FCT), ABUJA

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ABSTRACT

The provision of services, encompassing substandard medical facilities, inadequate housing conditions, limited access to electricity, insufficient recreational amenities, and the absence of potable water supply, has emerged as a significant impediment confronting Internally Displaced Persons (IDPs) both domestically and globally. The present investigation sought to evaluate the impact of service delivery on the welfare of IDPs residing in the Federal Capital Territory (FCT), Abuja. The objectives of this inquiry were to assess the socioeconomic attributes of the IDPs, scrutinize the types and efficacy of service delivery within the IDP camps, and appraise the consequences of service delivery on the well-being of the IDPs in the research area. For this study, we selected a representative sample of 331 households to examine the households encompassing the IDPs. The data underwent statistical analysis employing the Statistical Package for Social Sciences (SPSS). The findings unveiled the extent of deprivation endured in terms of essential amenities such as shelter, proper sanitation, reliable electricity, potable water, and adequate healthcare provisions. For instance, all participants resided in makeshift accommodations, including tents, plank houses, schools, and sack houses, with over 80% expressing concerns regarding security issues within the IDP camps. Consequently, this investigation concludes that the research area grapples with challenges encompassing food insecurity, personal security, criminal activities, fear of crime, poor health, limited educational opportunities, and precarious livelihoods, thereby augmenting vulnerability and diminishing the quality of life experienced by Internally Displaced Persons. Accordingly, the study offers recommendations advocating for comprehensive planning measures targeting IDPs in Abuja with the purpose of enhancing their well-being and overall quality of life.

Keywords: Delivery; Displacement global; Planning; Service

1. INTRODUCTION

The phenomenon of urbanization poses a significant, global problem, giving rise to various predicaments worldwide (UNDP, 2015). The challenges arising from urbanization have resulted in both natural and man-made disasters, thereby endangering the well-being and assets of individuals residing in urban and rural regions alike.

Urban populations interact with a modified environment, primarily due to their consumption of resources like food, energy, water, and land (UN-Habitat, 2016). Environmental hazards such as global warming, flooding, desertification, landslides, earthquakes, droughts, and individual displacement manifest the consequences of urbanization.

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The occurrence and detrimental effects of Internally Displaced Persons (IFPs) have garnered global attention due to their frequent incidence and the adverse impact they have on the societal, cultural, political, and economic aspects of affected individuals (IDMC, 2014). The rise in international conflicts during the early 1950s led to a prevalent discourse surrounding refugees. The establishment of the United Nations High Commission on Refugees (UNHCR) in 1950 was a direct response to the aforementioned circumstances (UN-Habitat, 2015). The primary objective of this commission was to provide protection and assistance to individuals who have been forcibly displaced (UNOCHA, 2014). Consequently, the matter of Internally Displaced Persons (IDPs) has become a prominent topic in national and international discourse, as well as a focal point for strategic planning in numerous countries and regions worldwide.

On a global scale, the number of individuals compelled to abandon their homes due to natural disasters or conflicts resulting in violence, loss of life, and human rights violations has exceeded 40 million (World Bank, 2015). Whether displaced within their own country as internally displaced persons (IDPs) or seeking refuge outside their nation as refugees, these individuals face immense challenges (World Bank, 2015). Particularly in Africa, various crises across the continent have displaced approximately 3.2 million individuals (World Bank, 2015).

Despite considerable government spending and fiscal allocations, internally displaced persons (IDPs) continue to encounter challenges related to governance, inefficiencies, infrastructure deficiencies, and inadequate service provision (Mohammed, 2017). Unregulated population growth from an influx of migrants from rural areas, without corresponding infrastructure development, further exacerbates these issues (UN-Habitat, 2015). Omar (2009) posits that inadequate planning is the primary cause of poor service delivery, while ineffective implementation can sometimes impede well-designed plans and policies. Additionally, he argues that a lack of transparency and accountability in governance, a shortage of skilled professionals in local government bodies, and a fragile relationship between urban areas and local governments exacerbate this problem (Omar, 2009).

The International Organization for Migration (IOM) conducted an assessment in 2018 and found that radical Islamist-instigated communal clashes in Nigeria resulted in the displacement of 13.3% of individuals. Natural disasters accounted for less than one percent of the displacement, while clashes between herders and farmers caused 1.2%. The remaining 83.8% of displacement was due to attacks by insurgents. To summarize, out of the 3.6 million people who experienced displacement across various regions in Africa, a staggering 2.2 million were from Nigeria (IOM, 2018).

Moreover, according to the World Bank's (2014) findings, approximately 1.1 million individuals in the African Sahel regions endure forced displacement due to conflicts. Notably, the 2012 crisis in Mali recorded approximately 353,000 internally displaced persons (IDPs), and an additional 280,000 refugees from Sudan sought refuge in Chad. strous result (World Bank, 2014; World Bank, 2015) highlight the unpredictability of the region and the challenge for those displaced who seek to return to their place of origin. UNCHR (2005) discovered that in some African countries, there could be at least ten internally displaced persons in every refugee camp.

In Nigeria, governments at all levels remain concerned about the issue of Internally Displaced Persons (IDPs) (UNHCR, 2005). Following independence, the civil war between 1967 and 1970 resulted in a significant number of IDPs in Nigeria, displacing a large population of eastern Nigerians. More recently, Nigeria has faced numerous challenges, such as ethnic and religious clashes, communal disputes over boundaries, conflicts between farmers and pastoralists over grazing lands, and widespread flooding across states, all of which have led to an unprecedented increase in the number of IDPs (Adeejat-Kubra, 2013).

The Federal Capital Territory (FCT) of Nigeria, as the seat of power, has been seen by IDPs as a safe haven, resulting in an influx of displaced individuals from both nearby and distantly affected states. In 2015, reports indicated that the number of IDPs in Abuja reached 13,786 (IDMC, 2015). Various satellite towns and surrounding villages host the camps. Some individuals in the camps have returned to their home states in recent years, while others have merged with existing camps within the FCT. However, the increasing population of the host communities has put a strain on available infrastructure such as electricity, clean water, and educational facilities. Consequently, the impact of IDPs on education is felt not only by the displaced individuals themselves but also by the host communities (Edem-Nse et al., 2017).

Abuja has faced an influx of IDPs due to the rise in insurgency and herders-farmer's clashes in the country (Edem-Nse et al., 2017). According to IDMC (2018), (1%) of the IDPs are located within Abuja. In the year 2018, internally displaced persons (IDPs) underwent a process of reintegration with their respective communities. Consequently, the population of the two remaining camps has significantly increased due to the amalgamation of additional individuals from the Karmajiji/Kuchigoro and Durumi camps. Consequently, the total count of individuals residing within these camps has reached 15,154, distributed across 2,510 households. Even with this large number of IDPs in Abuja, National Emergency Management Agency (NEMA) claims the camps are informal.

With the proliferation of IDPs camps in the Federal Capital Territory of Abuja, the provision of services to internally displaced persons (IDPs) has emerged as a significant obstacle. As a result, researchers and policymakers have been drawn to investigating the underlying causes of the escalating plight experienced by IDPs residing in the two camps within the FCT. The primary objective of this study is to evaluate the efficacy of service delivery within IDP camps, with the following specific aims: (1) to appraise the socio-economic characteristics of IDPs in these camps; (2) to scrutinize the types and effectiveness of service provision to IDPs residing in the camps; and (3) to assess the impact of service delivery on the overall well-being of IDPs.

The Federal Capital Territory is situated at the geographical midpoint of the nation, with coordinates of 9°4N 7°29E / 9.066667°N 7.483333°E respectively. It encompasses a total area of approximately 8,000 square kilometres. It is bordered to the north by Kaduna state, to the west by Niger state, to the east and southeast by Nasarawa state, and to the southwest by Kogi state (Figure 1 and 2). The FCT encounters two distinct weather conditions throughout the year, like in many other Nigerian states. These conditions consist of the rainy season, which commences in March and extends until October, and the dry season, characterized by abundant sunshine, which begins in October and concludes in March. The northeast trade wind brings about a brief spell of harmattan between these periods, resulting in a dusty haze, intense coldness, and dryness. Nonetheless, the elevated altitude and undulating terrain of the FCT serve as a moderating influence, ensuring that the weather remains consistently temperate.

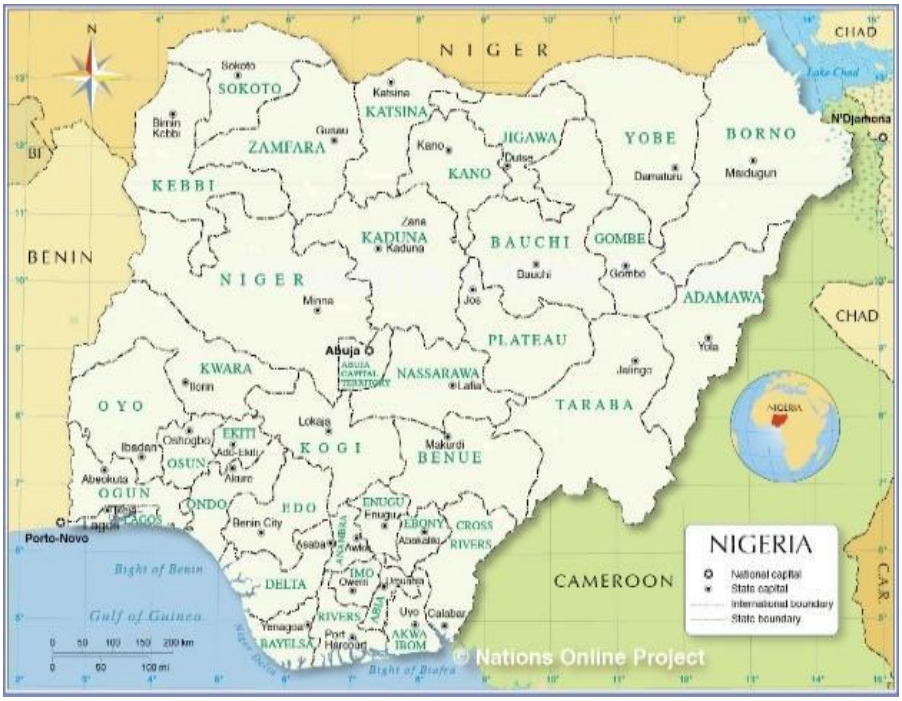

Figure 1 Map of Nigeria

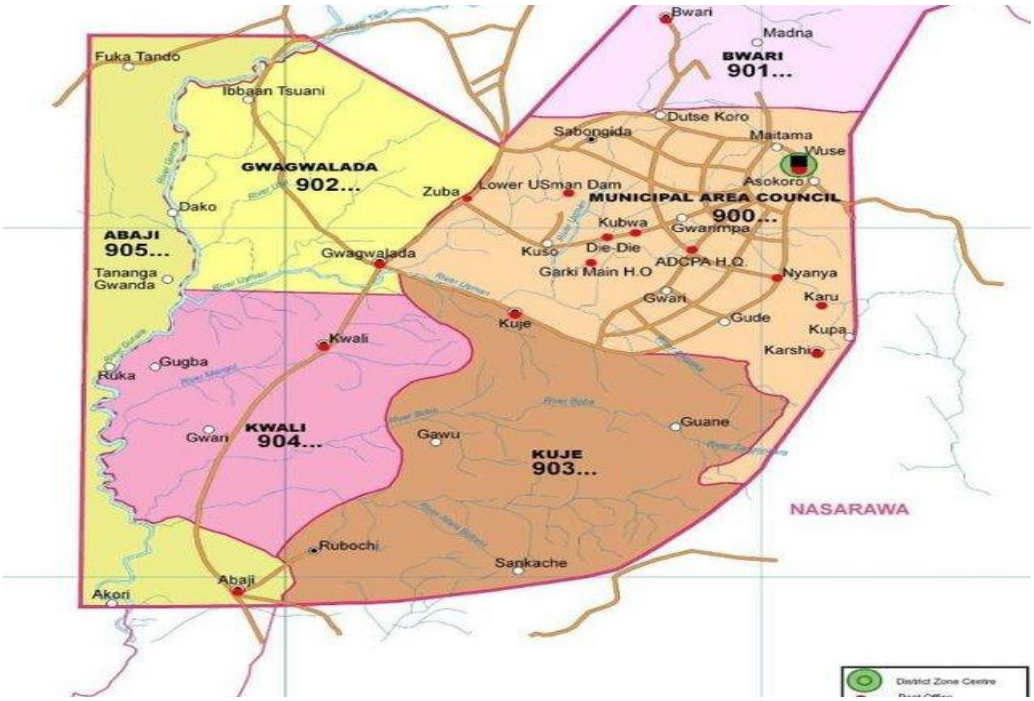

Figure 2 Map of FCT, Abuja

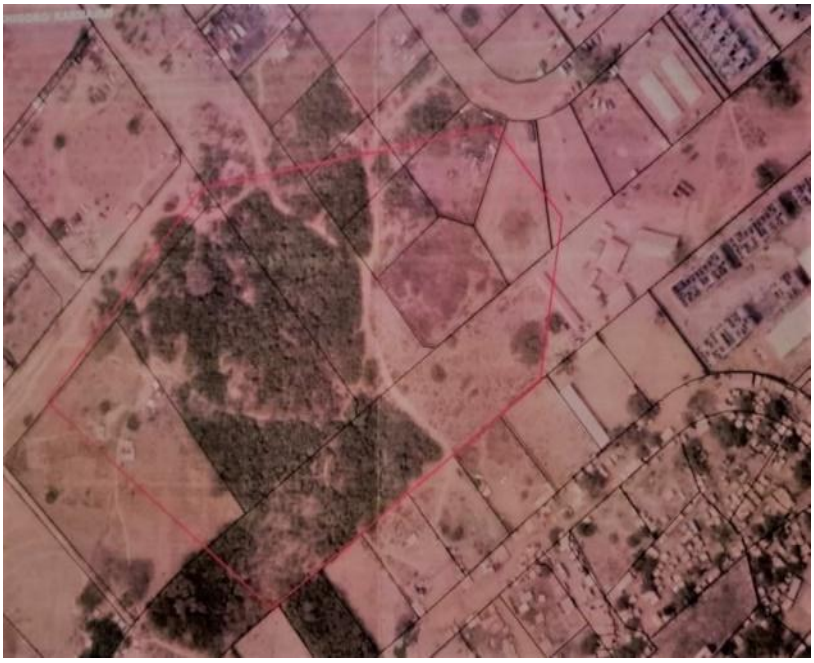

Figure 3 Google Earth Image of Kushigoro Camp

Figure 4 Google Earth Image of Durumi Camp

Kuchigoro/Karmajiji and Durumi represent two suburban areas that fall within the jurisdiction of the Federal Capital Territory. These villages are situated in the Abuja Municipal Areal Council (AMAC). The Kuchigoro/Karmajiji camp, as illustrated in Figure 3, is conveniently positioned a mere 5 minutes away from the central region. Its specific location can be found immediately after passing through the city gate along the outer southern expressway (commonly referred to as the Airport Road). On the other hand, Durumi, depicted in Figure 4, is bordered by the Kaura District to the north and can be reached within a reasonable 10-minute drive from the central area. The primary inhabitants of both settlements are the Gbagyi people, renowned for their expertise in agriculture as their main means of sustenance. Nevertheless, other Nigerian individuals who work in the city of Abuja can also be found coexisting within these communities.

2. LITERATURE STUDY

Failures in the provision of governmental services have been contributing factors to the occurrence of violence in urban areas, as acknowledged by the United Nations in 2016. Similarly, Omar (2009) noted that inadequate services, such as the absence of clean drinking water, inefficient waste management systems, substandard healthcare, insufficient housing, educational institutions, recreational facilities, telecommunication services, and electricity, are prevalent rather than exceptional in most Nigerian cities. These challenges are further exacerbated by population growth resulting from an increase in the influx of people from rural areas without a corresponding expansion of infrastructure. Deficient urban service delivery can largely be attributed to inadequate planning, while in some instances, sound plans and policies are hindered by their poor implementation, as highlighted by Omar (2009). This issue is clearly evident, primarily due to the lack of transparency and accountability in governance, a scarcity of skilled and professional personnel at the local government level, and a fragile relationship between urban areas and their corresponding local authorities, as emphasized by Omar (2009). These factors have exposed urban areas to a heightened state of insecurity. Correspondingly, UCLG (2013) and UN-Habitat (2017) assert that urbanization contributes to soil erosion within urban areas and, on occasion, leads to flooding, compelling residents to relocate involuntarily from their place of residence.

Good governance practices serve as effective tools for ensuring the security of our urban areas (Adeboye, 2015). As reiterated by Danlami (2015), good urban governance entails the city government's accountability to its residents, including those who are economically disadvantaged. We can argue that addressing insecurity is a fundamental aspect of good governance in both urban and rural areas. The notion of good governance and safe cities is mutually beneficial, as it allows residents to live without fear and guarantees their safety, thereby enabling their interaction with public institutions (Adefisoye, 2015). Adeboye (2015) supports this view by emphasizing that combating urban violence falls within the purview of good governance, particularly through the implementation of solidarity practices, city consultation processes, and institutional reforms that facilitate citizen participation.

A key factor contributing to urban violence and subsequent displacement is the failure of state institutions to regulate and effectively manage the legitimate use of force. Muggah (2014) highlights this, identifying three interconnected factors that significantly contribute to urban fragility, particularly in sub-Saharan African regions and globally. These factors include uncontrolled and unregulated urbanization, deficiencies in national and city-level governance, and the profound impact of internet connectivity and empowerment brought about by globalization.

2.1. Theory of Relative Deprivation

The development of the theory of relative deprivation took place in the late 1940s. According to Smith et al. (2015), this concept found widespread application in various fields such as sociology, psychology, urban planning, and political science. Saleh (2012) explained that in situations where racial discrimination, economic discrimination, disparities in living standards compared to other ethnic groups, and unequal access to state resources like land, wealth, and economic opportunities exist, ethnic conflict becomes more probable. In environments characterized by high levels of social discrimination, the dominant ethnic group exerts aggression and enforces a nationalist ideology, suppressing the customs and language of minority groups. Based on these points, it is reasonable to assert that violence or conflict in urban and rural areas can arise from ongoing deprivation of basic social amenities, ethnic politics, and a lack of inclusiveness in government.

Relative deprivation has been defined by Gur (1971) as the tension that arises due to the gap between the desired and actual satisfaction of collective values, which exposes people to violence. According

to Gurr's definition, relative deprivation is the disparity between what individuals truly desire in terms of value fulfillment and what they actually gain in terms of value accumulation capabilities. Elites seek to attain political power and social recognition through the utilization of ethno-religious ideologies (Amalie et al., 1999). While Saleh (2012) argues that any alteration in the balance of power between the state and its citizens triggers ethnic grievances and mobilizes them against the government, Gurr (1971) counter-argues that a state can survive despite intense discontentment as long as the regime maintains cohesive control and institutional support. This implies that social uprisings often occur due to calculations of power imbalance between deprived groups and oppressive groups on one side and the oppressive state on the other.

The significance of this theory in relation to this research lies in its ability to uncover the source, essence, and course of violence and conflict in both urban and rural regions. Political, regional, sectorial, and ethnic marginalization have embroiled our communities in various conflicts. By implementing measures such as resource allocation and power distribution, we can greatly mitigate these conflicts.

3. METHODS

This research employs a research design method known as cross-sectional, which is limited to a specific geographical area at a given point in time (Weerasekera 2015). It should be noted that cross-sectional studies aim to examine the level or frequency of a particular phenomenon, such as exposure, disease, or the effect of a phenomenon, at a specific point in time. Similarly, it can be said that cross sectional research is observational in nature, allowing researchers to gather information about a phenomenon without manipulating it. Therefore, a reconnaissance survey of the study area initiates this research, and both primary and secondary sources provide the research data.

In this research, multistage systematic random sampling techniques are employed. This technique divides a large population into stages to make the sampling process more practical (McBurney and White 2014). Each sample at any stage must have an equal chance of selection for multistage sampling to qualify as probability sampling. We adopted this method to eliminate subjectivity and bias in the research by giving every member of the sample an equal chance of selection (Danlami, 2015). Using the Krejcie and Morgan (1970) standard, a sample of 331 (representing 10%) was drawn from the total IDPs households of 2,510 and a total IDPs population of 15,154 in FCT (IDMC, 2018).

The study utilized both primary and secondary data. We obtained the primary data by administering well-structured questionnaires to both the IDPs and the agencies responsible for their management. We also made personal observations and captured pictorial information using a camera. On the other hand, the secondary data consisted of information gathered from FEMA, NEMA, Nigeria Police Force (NPF), Nigeria Security and Civil Defence Corps (NSCDC), reports from international and local NGOs, as well as published and unpublished literature reviews. We employed descriptive statistical techniques to analyze the field data, presenting the study data in the form of tables, charts, and graphs for easy interpretation. We conducted data analysis using Microsoft Excel and the Statistical Package for Social Sciences (SPSS).

4. RESULTS AND DISCUSSION

4.1. Socio-economic Characteristics of IDPs

Table 1 displayed the gender composition of the individuals participating in the survey. It is evident that 71% of the respondents were male, whereas the remaining 29% were female. This indicates that

the researchers specifically targeted the heads of households for the interviews, as they are typically the primary earners in their families.

Table 1 Gender of Respondent

Gender	Respondent	Percentage
Male	140	71.0
Female	110	29.0
Total	**250**	**100.0**

Figure 5 depicts the age distribution of the respondents. The data reveals that 13.0% of the participants fall within the age range of 18–27, while 13.8% belong to the age group of 28–37. Furthermore, 30.5% and 5.0% of the respondents are aged between 48-57 and 58 years and above, respectively. This implies that the majority of the individuals surveyed are adults who are willing to provide the necessary information for the research project.

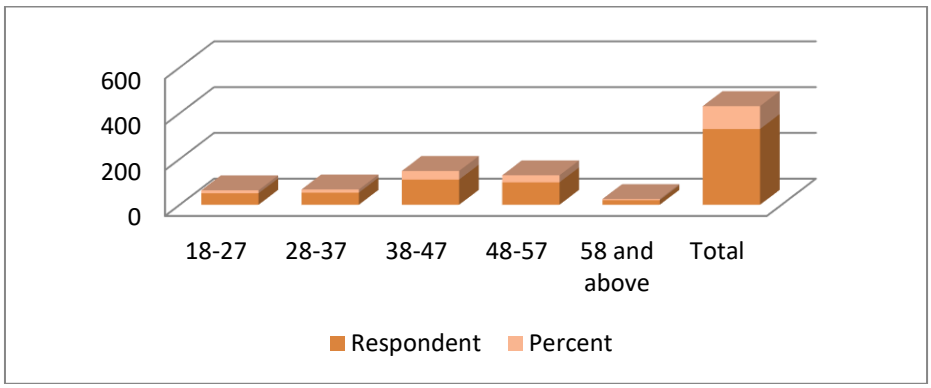

Figure 5 Age Distribution of the Respondents

Figure 6 illustrates the educational achievements of the internally displaced individuals in Abuja. According to a field survey, it was revealed that 25% have received primary education, 12% have obtained secondary education, and 8% have pursued tertiary education. Additionally, 40% have attended Islamic or Bible schools, while 15% have undergone informal educational processes. Therefore, it can be inferred that the individuals residing in the IDP camps in Abuja have not surpassed secondary education.

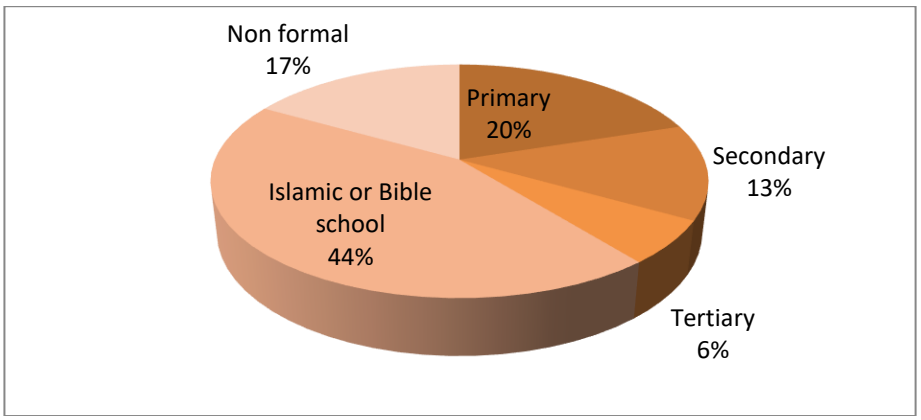

Figure 6 Educational Qualification Respondents

Table 2 displays the marital status of the participants within the designated study region. The survey findings reveal that 27% are in a married state, 15% are unmarried, and 17% and 40% are divorced and widowed, respectively. Nevertheless, it is noteworthy that 40% of individuals who are widowed are predominantly women due to the active participation of men in the battle against insurgency.

Table 2 Gender of Respondent

Marital Status	Respondents	Percentage
Married	110	27.9
Single	55	15.0
Divorced	43	17.0
Widowed	123	40.1
Total	**331**	**100.0**

Table 3 presents findings indicating a significant proportion of internally displaced persons (IDPs) engage in various occupations. Specifically, we can classify 23% of the IDPs as students, and 17% as civil servants. Additionally, over 20% of the IDPs are involved in artisanal activities, whereas 40% are farmers. Figure 7 depicts the disparity in educational attainment, suggesting that the number of artisans surpasses that of civil servants.

Table 3 Occupation of Respondent

Occupation	Respondents	Percentage
Student	84	23.0
Civil Servant	37	17.0
Artisan	70	20.2
Farmers	140	40.0
Others	0	0.0
Total	**331**	**100.0**

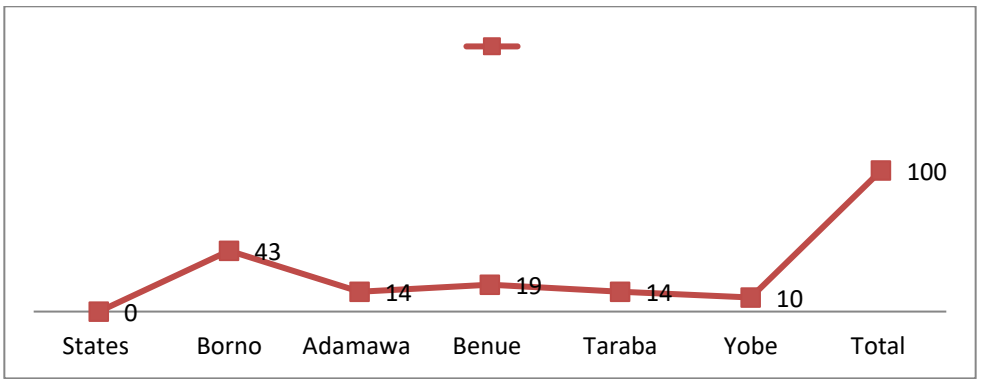

Figure 7 State of Origin of Respondent

Figure 7 delineates the states of origin from which the respondents, who currently reside in the IDP camps in Abuja, hail. The outcome of this analysis reveals that a significant portion, amounting to

43%, originates from Borno, while 14% stems from Adamawa. Additionally, 19% of the respondents' hail from Benue, with 14% originating from Taraba and 10% hailing from Yobe.

We conduct an evaluation in Table 4 to identify the underlying causes of IDP displacement in the Abuja camp. The findings indicate that a considerable proportion, comprising 39%, attribute their displacement to the activities of Boko Haram. Conflicts between farmers and herders uprooted another 24% of the displaced individuals. Moreover, flooding caused 19% of the displacement, while communal or ethnic clashes caused 10%. Unrelated to the aforementioned causes, the remaining 8% found themselves displaced. Evidently, the prevalence of Boko Haram insurgency and conflicts between farmers and herders emerge as the primary catalysts for the majority of IDPs in the designated study area.

Table 4 Reason for Displacement

Reasons	Respondents	Percentage
Boko Haram	139	39.0
Farmers/herders clash	78	24.0
Flood	69	19.2
Communal/ethnic clashes	30	10.0
Others	15	8.0
Total	**331**	**100.0**

4.1. Types and Effectiveness of Service delivery to the IDPs in the Camps

Table 5 explores the accommodation methods of the respondents; the survey findings reveal that 34% live in tents, 15% occupy school buildings, 21% use plant-based or wooden materials, and 30% use sacks and other materials for shelter. Therefore, we can infer that the lack of adequate housing affects internally displaced persons (IDPs).

Table 5 Types of Shelter

Types	Respondents	Percentage
Tent	95	34.0
School	60	15.0
Planks/wood material	85	21.0
Sacks and Leader material	91	30.0
Others	0	0.0
Total	**331**	**100.0**

Table 6 evaluates the security structure of the encampments within the designated study region. The findings reveal that a vast majority of 88% of the participants confirmed the absence of security infrastructure within the encampments, whereas the remaining 12% acknowledged the presence of security personnel in the vicinity of the encampments. This indicates that the encampments are devoid of essential security amenities, thereby posing a significant risk to the inhabitants' safety within the encampments.

Table 6 Presence of Security Facility in your Camp

Presence of Security	Respondent	Percentage
Available	60	12.0
Not available	271	88.0
Total	**331**	**100.0**

Table 7 explores the availability and origins of water supply to the Internally Displaced Persons (IDPs) residing in Abuja. It was uncovered that a significant proportion, specifically 80%, of the inhabitants lack the means to obtain a safe and drinkable water supply, while a mere 20% possess the privilege of accessing such a valuable resource. In addition, the principal sources of water for domestic purposes within the camps primarily consist of streams, accounting for 49.24%, and wells, comprising 31.43%. Only a minuscule fraction, approximately 1.51%, of the IDPs have the opportunity to utilize pipe-borne water. This data effectively highlights the severely insufficient provision of pipe-borne water supply within the designated research site, thereby signifying a deplorable level of service delivery to the IDPs.

Table 7 Availability of Potable Water Supply

Availability of water	Respondent	Percentage
Available	90	20.0
Not available	241	80.0
Total	**331**	**100.0**
Pipe borne	5	1.51
Stream	163	49.24
Water vendor	44	13.29
Well	104	31.43
Borehole	15	4.53
Total	**331**	**100.0**

Table 8 presents data on the availability of sanitation services and the level of satisfaction derived by users from utilizing convenience facilities in the IDP camps situated in Abuja. The findings revealed that a mere 15.41% of internally displaced individuals indicated the presence of toilet facilities, while a significant 78.85% emphasized the absence of such amenities within the camps. Furthermore, 5.74% expressed uncertainty regarding the availability of toilet facilities. Additionally, a noteworthy 84.59% of internally displaced persons were found to engage in open defecation practices, indicating a prevalent and unsatisfactory sanitation situation among the IDPs. As a result of these findings, it was determined that a substantial 61.63% of the IDPs residing in the study area expressed dissatisfaction, with an additional 19.34% expressing extreme dissatisfaction with the toilet facilities in the area under investigation.

Table 8 Availability of and the Level of Users' Satisfaction with Toilet Facilities in the IDPs

Availability of Toilets	Respondents	Percent
Available	51	15.41
Not available	261	78.85
Not sure	19	5.74
Total	**331**	**100.0**
Toilet type		
Water closet	9	2.72
Aqua privy	11	3.32
Pit latrine	31	9.37
Open defecation	280	84.59
Total	**331**	**100.0**
Satisfaction with toilet facilities		
Extremely satisfied	6	1.81
Satisfied	9	2.72
Neutral	48	14.50
Dissatisfied	204	61.63
Extremely dissatisfied	64	19.34
Total	**331**	**100.0**

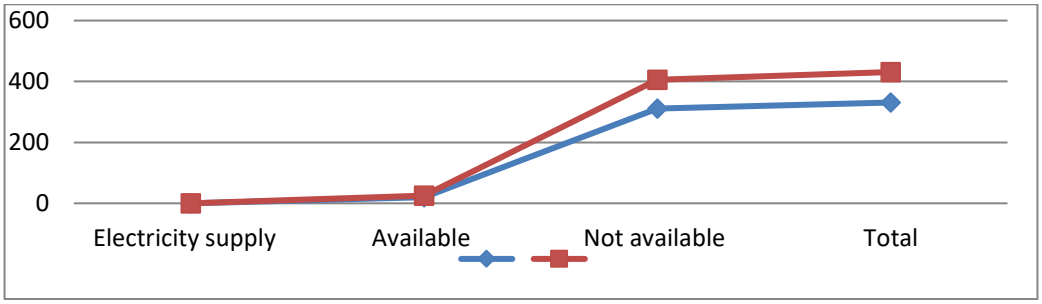

Figure 8 Availability of Electricity

Figure 8 analyzes the presence of electricity supply within the designated study area. The findings from the survey indicate that a mere 5% of the participants possess the privilege of accessing electricity, whereas a staggering 95% of the respondents are devoid of this essential amenity. Therefore, the lack of electricity provision affects the internally displaced persons (IDPs) living in this region.

We emphasize that stakeholder engagement throughout each project stage is essential for obtaining support, managing expectations, and mitigating risks. Engaging with stakeholders, including local communities, can help prevent delays, cost overruns, and project failure.

We highlight community participation in infrastructure project implementation to foster a sense of community belonging, purpose, contribution, and acceptance. This aligns with findings from other studies, such as those by Barclay & Klotz (2019) and Di Maddaloni & Davis (2017), emphasizing

the importance of considering the impact on all stakeholders, including local people, from the early stages of project development.

In summary, the challenges in infrastructure development in Zambia primarily revolve around the need for greater community engagement and consideration. Addressing these challenges requires involving the public in decision-making, prioritizing infrastructure projects, and actively incorporating their ideas. Effective communication, stakeholder engagement, and community participation throughout project implementation are essential for successful infrastructure development in newly created districts.

a b

Plate I Type of Shelter and Toilet at Kuchigoro Camp

4.3. The Effects of Service Delivery on the Well-being of the IDPs

The performance of services in IDP camps is succinctly outlined in (Table 9). The variable that exhibits a performance exceeding the overall average score of a camp demonstrates the least satisfactory level of performance. According to Table 9, the provision of food in Kuchigoro (4.154) and Durumi (4.037) attains the highest scores, thereby signifying that these camps confront food insecurity. Consequently, the accessibility aspect (2.803) in Kuchigoro camp proves to be satisfactory since it exhibits the lowest score in the camp. Conversely, in Durumi camp, electricity demonstrates the lowest score (3.180), thereby indicating that electricity is not an obstacle, despite its unavailability.

Table 9 Performance of Services in the Camps

Facility	Durumi camp Mean	Kuchigoro camp Mean
Water supply	3.350	3.788*
Electricity	3.145	3.180
Education	3.316	3.502*
Healthcare	3.744*	3.862*
Security	3.009	3.410*
Accessibility	2.803	3.530*
Relief Materials	3.744*	3.770*
Food Provision	4.154*	4.037*
Shelter	3.504*	3.631*
Sanitation	3.214	3.475*
Average	**3.398**	**3.618**

Note: All asterisk facilities (8) have poor performances of service delivery

By inference, the healthcare service exhibits a performance rating of (3.744), whereas relief materials and food demonstrate a lower performance level, thus posing a threat to the well-being of the Internally Displaced Persons (IDPs) residing in their camps. The Human Development Index (HDI) acknowledges the significance of food production and health in attaining human capacity development. Therefore, we can infer that the IDPs in Abuja have made limited progress towards human development. Table 10 illustrates the efficacy of service provision in relation to the well-being of IDPs in their camps, with an overall average score of (3.826) for Kuchigoro camp and (3.601) for Durumi camp. The significant index value and average score indicate notably inadequate service provision in this aspect, negatively impacting the IDPs' well-being.

Table 10 Effectiveness of Service Delivery on Well-being of the IDPs in the Camps

Facilities	**Durumi camp**	**Kuchigoro camp**
	Mean	**Mean**
Environmental Quality	3.350*	3.392*
Personal Security	4.137	3.631*
Shelter	3.487*	3.607*
Access to Jobs	3.573*	3.539*
Assess to Balanced Diet	4.530	3.982
Sanitation	3.880	3.456*
Average	**3.826**	**3.601**

Note: all asterisk facilities (*) have effect on the well-being of the IDPs

c d

Plate II: Environmental Quality in Kuchigoro and Durumi Camps

Consequently, the highest scores for access to a well-balanced diet are observed in the Kuchigoro (4.530) and Durumi (3.982) camps. This indicates that there is a food crisis in these camps, resulting from a shortage of food and inadequate dietary practices. Consequently, the wellbeing of internally displaced persons (IDPs) is negatively affected. In addition, personal security in the Kuchigoro camp (4.137) also plays a significant role in the wellbeing of the IDPs, as they live in constant fear of another attack. However, the IDPs in both the Kuchigoro and Durumi camps do not believe that service delivery has a significant impact on the environmental quality of their surroundings, with scores of 3.350 and 3.392, respectively. Therefore, this study provides evidence that the IDPs in Abuja lack access to sufficient food, relief materials, and adequate shelter. It is therefore evident that the provision of services to the IDPs in the Federal Capital Territory (FCT) is of poor quality.

5. CONCLUSION

The research extensively examined the challenges faced by Internally Displaced Persons (IDPs) in the Federal Capital Territory, Abuja, Nigeria, with a particular focus on the impact of service delivery on their well-being. The concentration of individuals with low socio-economic status in the Kuchigoro and Durumi IDP camps has resulted in significant issues regarding the provision of services. Many inhabitants reside in makeshift dwellings consisting of tents, pollinating sacks, and wood. A majority (88%) of respondents acknowledged the problems pertaining to security, access to clean water, and the quality of healthcare services in the camps. The study found that in the Durumi camp, services related to shelter, food provision, relief materials, and healthcare were lacking, while in the Kuchigoro camp, all facilities, except for educational resources, were deemed inadequate. Consequently, the research demonstrated that environmental conditions, shelter availability, and job opportunities significantly influence the well-being of IDPs in the Federal Capital Territory, Nigeria. Thus, the study recommends the adoption of sustainable strategies to address the challenges faced by IDPs in collaboration with international and local non-governmental organizations. Furthermore, the government should provide training and empowerment initiatives for IDPs to enhance their livelihoods and create viable employment prospects for them. It is essential to involve non-governmental organizations and voluntary associations in the implementation and monitoring of service delivery to IDPs, as the responsibility of providing basic amenities should not solely rest upon the government.

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SOCIO-ECONOMIC EFFECTS OF ORISUMBARE SAWMILLING INDUSTRIES ON THE RESIDENTS OF IKIRE, IREWOLE LOCAL GOVERNMENT AREA OSUN-STATE, NIGERIA

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ABSTRACT

The study examined the socio-economic effects of the Orisumbare sawmill industry on the residents of Ikire, Irewole local government area of Osun State. The objectives of the study include, examination of the socio-economic characteristics of the respondents, the positive effects of industry on the residents, the negative impacts of industry on the residents, and the perceived environmental-induced diseases caused by industrial activities. A case study research design was adopted, while both primary and secondary data were utilised. A multistage sampling technique was used, in which a buffer zone of 900m radius was made to delineate the zone of industries' influence. This was later stratified into three zones, and a household head found in each of the residential buildings within the zone was randomly selected. A questionnaire was administered to 261 household heads in the sampled buildings. The collected data were analysed using both descriptive and logistic regression. Orisumbare sawmill had a positive significant impact on the residents of Ikire (F = 0.858). Sawmill activities have a significant effect on the socio-economic lives of the residents. Cottage industries should be harnessed in order to explore their opportunities, since the resources are not fully utilised.

Keywords: Industries, Ikire, Orisumbare sawmill, Socio-economic impact, Sawmill

1. INTRODUCTION

The existence of industrialisation and urbanisation in developing countries has an enormous impact on natural and man-made environments. The more advanced a nation's industrial capacity, the greater its prospects for economic growth and expansion. If carried out in a sustainable way, taking into consideration the frequently delicate nature of the environment, societal arrangements, and economic circumstances, this can accomplish enduring improvements in living standards, incomes, working conditions, education and healthcare. Industrialisation has been a diversified benediction to mankind. Indeed, since the dawn of civilisation, industries have been established to meet various human needs (Ugheoke et al., 2006). According to Odubela and Omoniyi (2001), it enhances the quality of life. Industrial activities like mining, manufacturing, sawmilling, etc. are important to the economy of a nation as they support and service rural activities and also provide employment opportunities for the general populace. In Nigeria, the primary wood processing industries are classically large-capacity facilities, which include large sawmills, particleboard mills, plywood mills, pulp plants, and paper plants.

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Correspondingly, there exist a fairly large number of small-scale wood product manufacturing companies like furniture industries, cabinet makers, and carpentry (Raw Materials Research and Development Council [RMRDC], 2001). Meanwhile, sawmill industries, which are the focus of this study, have largely been responsible for converting logs into lumber using different methods such as live sawing (sawing around the log), slash cutting, and sawing facilities. The majority of sawmill industries are located in the wood-producing rainforest areas, especially in the southern states of Nigeria (Bello and Mijinyawa, 2010). Thus, the largest concentration of sawmills is in Lagos, Ekiti, Osun, Cross River, Ondo, Oyo, Imo, Edo, Delta, and Ogun States (Bello and Mijinyawa, 2010). Together, they accounted for over 90% of the sawmilling activities in the country (Raw Materials Research and Development Council (RMRDC, 2003). The sawmill industry ranges from small (81%), medium (13%), to large (6%) in the percentile proportion (RMRDC, 2003). Presently, the industry accounts for about 93 percent of the total number of wood-based industries in Nigeria (Fawupe, 2003).

As rightly opined by Ajibefun and Daramola (2004), the sawmilling industry, among other microenterprises, is in the vanguard of promoting the economic growth of the country. The contribution of the sawmilling industry to the country's gross domestic product surpassed that of all other sectors of the economy in the early 1960s except the petroleum industry (Adenuga and Omoluabi, 2005). The industry employs a significant proportion of the rural population in clerical and technical jobs such as power saw operators, saw doctors, and mechanics, as well as in the distribution and wholesale of wood products (Alvar, 1983). The realisation of the impacts of the sawmill industry on the built environment has motivated various researchers. In recent years, Dosumu and Ajayi (2002) assessed the problems and management of sawmill waste in Lagos. They observed that sawmills, by nature, generate a lot of waste sawdust. In the absence of a proper disposal method, those wastes were burned in the open air. The study concluded that air pollution as a result of waste burning will certainly constitute a health hazard to the population in that particular area. Likewise, Anervbcrokhai (2008) considered the physical effects of sawmilling activities in relation to the well-being of residents in the study areas. His findings showed that sawmilling activities generate toxic substances that are transported considerable distances away from the source and become accumulated in soils and water bodies, as well as physical damage to structures such as cracks in the walls and deterioration of buildings. Okunomo and Achoja (2010) examined the impact of the African timber and plywood industry on the Sapele community in Delta, Nigeria. They concluded that the sawmill industry has a significant impact on the Sapele community through the provision of social amenities and wood supply.

While studies have focused on either the positive or negative impact of the industries on the host communities, there is a dart of holistic empirical investigation on the effects of the sawmilling industry. This is a major gap the present study wants to fill by investigating the effects of Orisumbare industries on the residents of Ikire, Irewole local government area, Osun State, Nigeria.

In achieving the study, the following objectives are set: 1) To examine the socio-economic characteristics of the residents. 2) To examine the positive effects and negative impacts of the industry on the residents in the study area; and 3) To identify the perceived environmentally induced ailment caused by the industrial activities. Furthermore, in order to ascertain the level of the impact, a hypothesis states that Orisumbare sawmill activities have no significant impact on the socio-economic lives of the residents in the study area.

2. STUDY AREA

Ikire is an ancient Yoruba city, situated in the Irewole local government area in south-western Nigeria, Osun State. It lies between latitude 7° 10’ North East of the equator and longitude 4° 151 east of the Greenwish meridian. Irewole local government area covers a total land area of about 204.5km and is located 11 km southwest of Gbongan (the capital of Ayedaadee local government), 33km east of Orileowu, 39km north of Ayedire local government area, 15km north west of the river Osun, and 4km north east of Isokan local government area, Apomu. The administrative headquarters of the local government is Ikire, which is surrounded by some rural communities. Ikire is within the tropical rainforest, and by that, there is a large expanse of forest (government reserve and free reserve), which is a source of timber in the forest around Ikire.

The geographical position of the local government regarding fertile soil in the rainforest affords a greater opportunity for the inhabitants to earn a living. Ikire's inhabitants primarily engage in farming activities, following a subsistence agricultural system that involves cultivating a small plot of land. The chief crops grown in his area are plantains, bananas, cassava, maise, okro, tomatoes, and potatoes for local consumption, and palm kernels, kola nuts, palm oil, and timber logs are commercial agricultural products. Due to the increase in physical developmental activities (building construction), sawmilling activities sprang up in every nook and cranny of the study area for the benefit of the people of Ikire and its environments (Larinde and Popoola, 2008; Adekoya, 2011; Fatoki, 2017; Olanrewaju et al., 2023).

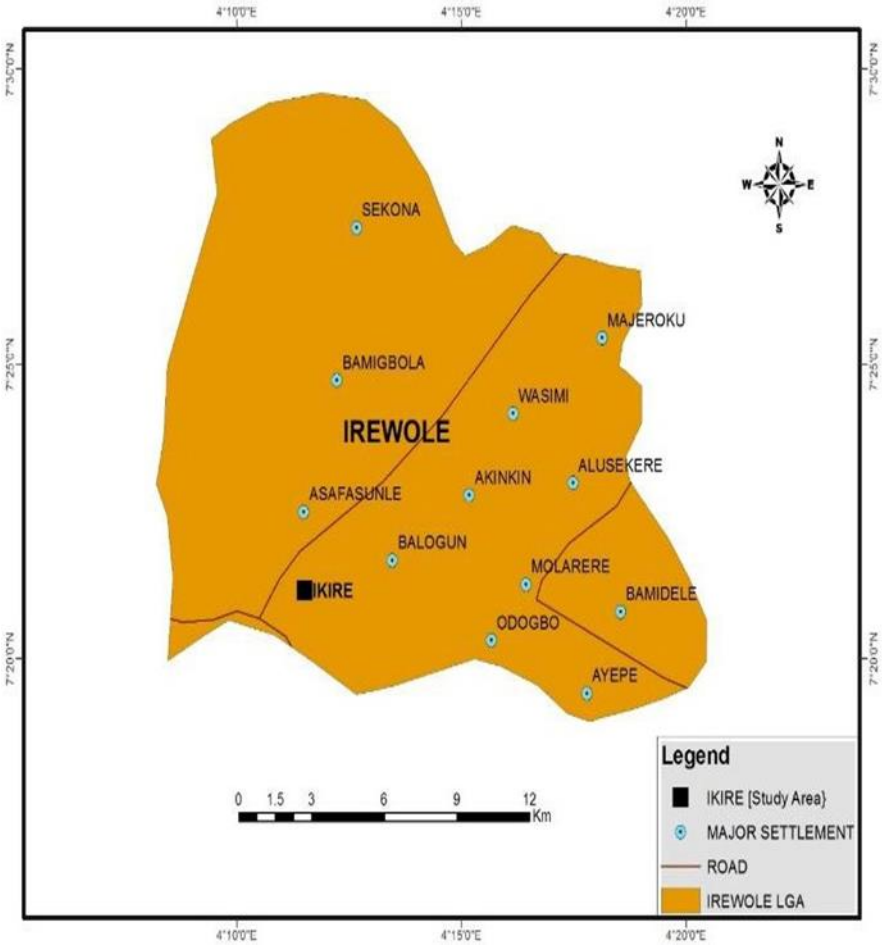

Figure 1 Ikire in the Context of Irewole Local Government Area
(source: Federal Ministry of Land and Survey, 2018)

3. THEORETICAL FRAMEWORK LITERATURE REVIEW GROWTH POLE THEORY

Growth pole theory was developed by Perroux (1950), and it contributes to Myrdal's theory of cumulative causation in a more spatial context. In growth pole theory, a growth pole refers to linkages between firms and industries. "Propulsive firms" are those larger than other firms, which act as a growth pole and generate growth through inter-industry linkages and multiplier effects for other smaller firms and overall regional development in a particular growth center. According to this theory, economic development strategies should focus on a certain development pole or the contributions of sector capital in order to stimulate the development of lagging regions. Perroux also believed that, with appropriate policies, urban centers can become growth poles in a multiregional context. Growth poles assumptions that economic development, or growth, is not uniform over an entire region but instead takes place around specific poles. These poles are often characterised by a key industry around which linked industries develop, mainly through direct and indirect effects. The expansion of this key industry implies the expansion of output, employment, and related investment, as well as new technologies and new industrial sectors.

Research on the development of growth poles theory in the regional context was traceable to Hirschman (1958) and Myrdal (1957). The constructive and destructive effects of relations between the growth pole and its surroundings were among the main scientific interests of Hirschman and Myrdal. The theory of the backwash and spread effect is an economic development effect suggested by the Swedish economist, Gunnar Myrdal. Myrdal (1957) proposed the hypothesis of circular and cumulative causation, which means that once an economy obtains a growth advantage, it will tend to keep it, and development will proceed more rapidly in certain regions than others. The cumulative movement that tends to weaken a region economically is termed backwash effects. It basically means that if one particular area in the country starts growing or developing, it causes people, human capital, as well as physical capital (infrastructure, finance, machines, etc.) from other parts of the country to gravitate towards this growing centre. This essentially leaves the other areas worse off than before because their brains and capital leave them to go to the growing centre. Investments and procurements in the environs of the growth pole by companies from the growth pole and job opportunities from deprived regions with high levels of advancement can be counted among the positive effects.

In order to demonstrate the negative effects, we can say that new striking investments are commonly situated in the growth pole, exhausting the most competent employee from the environments of the growth pole. Among the clarifications of immense significance made not only by Hirschman and Myrdal but also by other authorities is the one that states that negative effects gain an advantage over positive ones and that it takes quite a long time for positive effects to develop (Grzeszczak, 1999; Malizia, Feser, 1999). By application, the theory is used to explain how the existence of Orisunmbre as a growth pole could have bipolar effects on the socio-economic and sustainability of the residents of Ikire town and its surroundings.

The degree to which industrial development efficiently reduces poverty and inequity depends on the pattern of industrialisation in any given area (UNIDO, 2017). This is because industries employ a large number of unskillful workers and/or use domestic inputs and raw materials produced with labor-intensive technologies, which eventually have positive effects on the incomes of the poor. In Taiwan, for example, during the early phases of industrial development, the demand for unskilled workers increased relative to that of skilled workers, which reduced inequality and poverty (Matleena Kniivilä 2006). Industrial development has the potential to achieve a variety of social objectives, such as employment, poverty eradication, and greater

access to education and healthcare. At the same time, industrial processes can have negative environmental impacts, such as climate change, the loss of natural resources, air and water pollution, and the extinction of species. The forest products industry is a source of economic growth and employment, with the value of global forest products traded internationally reaching US$270 billion, of which developing countries account for more than 20 percent. Worldwide, forest industries provide employment (both formal and informal) for approximately 50 million people. Various authors have evaluated the forest industry's performance in Nigeria (GWV, 1994; RMRDC, 1991, 2003, 2009; Larinde, 2010; Ogunsanwo, 2010; Kukogho et al., 2011; Ogunwusi, 2012; Ogunwusi et al., 2013). established the forest industry, which was active and contributed significantly to local and international trade, particularly in the 1960s and 1980s, and currently still does.

The forestry subsector has over the years contributed immensely to the socio-economic development of the country, and it ranks among one of the highest revenue and employment generating sectors (GWVC, 1994; Sambo et al., 2007). The Nigerian sawmill has always played a crucial role in our economic development. For over a century, Nigeria has selectively and wastefully exploited its timber resources. Among the over 100 different usable timber species growing in Nigeria’s forest, less than 50 are being used commercially, while 6 out of 34 export species account for 80% of the total volume exported (Nigeria Export Promotion Council, 2000). Approximately six of the export species undergo further processing to become components for furniture for export. These are Teak (Tectona grandis), Red Apa (Afzelia Africana), Ekki (Lophira alata), Opepe (Nauclea diderchic), Mansonia (Mansonia altissima), and Iroko (Milicia excelsa).

Employment is critical to economic development; forest-based industries are relatively job-intensive compared to other industrial sectors. A large number of workers are employed in the sawmill industry for the harvesting and processing of wood. Examples of such employment are: felling operations, saw doctoring, transportation, milling, packing, etc. The Forest Management Evaluation Coordinating Unit (1992) submitted that about 75,000 people are directly involved in the industrial processing of logs. Consequently, this is about a quarter of the labour force in the manufacturing industry in Nigeria. The sawmill industry is one of the most important elements in achieving sustainable rural development in developing countries.

Indiscriminate logging in the rainforest and unrestrained felling of trees by sawmill operations are reported to have adverse effects on the environment. Adverse effects caused by the operations of forest industries include loss of biodiversity, migration of wildlife, ecological imbalance, soil erosion, flooding, desert encroachment, and disruption in the hydrological cycle of the area (Fuwape & Onyekwelu, 1995). Fuwape and Onyekwelu (1995) reported that the clear felling of trees by sawmills as a source of raw material has been recognised as one of the factors responsible for environmental degradation in arid and semi-arid parts of Africa. In Nigeria, there is an increasing rate of deforestation and forest degradation. Forest exploitation is beneficial to sawmills and other organisations, but it equally has an adverse effect on climate change if done irrationally. Wood dust (sawdust), a by-product of timber processing, is common in the sawmill environment. It contributes to job threats (Ugheoke et al., 2006). Taking into consideration these menaces, the Federal Government of Nigeria enacted the Factories Act of Nigeria in 1987 to protect the surroundings where the events take place. The regulation makes requirements for the health, safety, and welfare of people in the surrounding area of the sawmill (Federal Government of Nigeria, 1987). Nonetheless, the government is not implementing the rules for several reasons, such as inadequate manpower for implementation (Lasode and Balogun, 2010; Asogwa, 2000). Quite a number of studies on sawmilling operations have been undertaken in terms of the

environment and health effects (Boateng and Amedofu, 2004; Ugheoke et al., 2006; Verma et al., 2007; Edith and Nkwocha, 2012). Boateng and Amedofu (2004), in their study in Kumasi, Ghana, established that noise pollution from sawmill industries has a great impact on the hearing abilities of workers. Ugheoke et al. (2006) assessed the influence of smoking on respiratory symptoms and respiratory function among sawmill workers in Benin City and established that respiratory symptoms, especially sputum production and chest pain, are common among sawmill workers. Verma et al. (2007) assessed the operational health and safety issues in Ontario sawmills and found that noise exposure at many operations exceeds the Ontario occupational exposure limit, which is the same as ACGIH/TLV. Edith and Nkwocha (2012) assessed the impact of the sawmill industry on ambient air quality at the Utu community in Akwa Ibom State, Nigeria. The result of the study justified the need for epidemiological studies to determine the health effects on workers in the sawmill and the local population from continuous exposure to these gaseous emissions over the years. The aforementioned studies have established various research outputs done by authors with reference to the positive impact that sawmilling industries have on people on the one hand and the negative impact they have on host residents on the other. However, the holistic approach to studying this has not been given adequate attention in the literature; this is the gap the study intends to fill in the literature.

A case study research design was adopted, in which both primary and secondary data were sourced. Using multistage sampling techniques, a 900m buffer zone was made around the industries so as to delineate the zone of their influence. The 900m radius was later stratified into three zones: (1-300m, 301-600m and 601-900m). 261 (10% of 2606) residential buildings within the zone were randomly selected, and a household head was sampled in each building with a set of questionnaires giving credence to every 5th building in the study area (see Table 1). Information obtained includes socio-economic characteristics of the residents, perceived and negative effects of the sawmill industry, forms of industrial pollution, and perceived environmentally-induced ailments caused by industrial activities. The data collected were analysed using both descriptive and logistic regression statistics. All the data were validated at a P value of < 0.05.

Table 1 Sample Frame, Sample Size and Sampling Procedure

Location	No of Buildings	Sample Frame	Sample Size	No of Building Administered
1-300m	100	10%	10	10
301-600m	948	10%	95	95
601-900m	1558	10%	156	156
Total	**2606**	**10%**	**261**	**261**

(source: Author field survey, 2018)

4. RESULTD AND DISCUSSION

4.1. Socio-Economic Characteristics of Residents in the Study Area

This section examined the residents' socio-economic characteristics in different residential zones around the sawmill industry. Socio-economic characteristics considered include gender, age, marital status, religion, ethnicity, educational level, occupation, and average monthly income. All of these are presented in Table 2. Generally, analysis of the gender of the respondents revealed that less than half (44.8%) of the respondents were male, comprising 1.5% in locations 1 to 300m

16.9% in locations 301 to 600m and 27.2% in locations 601 to 900m. The result revealed that the majority of the respondents are female, and this is consistent across all strata. This could be traced to the nature of work done by males, which normally takes them out of home in the morning only to return in the evening, while the majority of females do menial jobs at home or around the house.

The age distribution of the respondents revealed that 15.3% were aged between 18 and 20 years, 45.7% were aged between 21 and 34 years, 33% were aged between 35 and 64 years, and 6.1% were above 70 years. Variation across the selected settlement revealed that 0.4% aged between 21 and 34 years in location 1- 300m, 20.7% aged between 35 – 64 in location 601- 900m and 3.8% aged between 65% and above. The results show that 21 to 34 years old is the highest age bracket among the respondents, and this could be traced to the presence of Osun State University hostels around the study area.

Regarding the marital status of the respondents, the investigation revealed that 36.8% were single, 48.7% were married, 10% were divorced, and 4.6% were widowed. The variation across the selected settlement revealed that, in locations 1- 300m and 301 to 600m, respondents who were single accounted for 2.3% and 19.9%, respectively. Variations on locational basis for married, divorced, and widowed are presented in Table 2.

Investigation on the ethnicity of the people living in the study area revealed that 79.3% of the respondents were Yoruba, 4.6% were Hausa, 11.5% were Igbo and 4.6% were from other ethnic groups such as Ebiras, Nupes, and Ijaws. From the analysis it was observed that the majority of the respondents within distance 601 to 900m were predominately Yoruba's compare with other ethnic groups. This can be linked to the fact that the study area is located in the heart of Yoruba land.

On account of the educational status of the respondents, 13% were illiterate, 11.1% had primary education, 37.5% had secondary education, and 38.3% had tertiary education. The study revealed that the majority of the respondents within a distance 1 to 300m had tertiary education, which accounted for 2.3% of the respondents in the study area. Although the proportion of respondents living in location 601-900m had 8.8% of respondents without formal education, investigation revealed that the majority of the respondents have average communication skills to understand, interpret, and answer the questionnaire appropriately. Investigation of the respondent's occupation revealed that 19.5% were civil servants, 32.2% were artisans, about 21.1% were students and apprentices, 12.6% were traders, 12.6% were farmers, and 1.9% were unemployed.

Analysis of the respondent's monthly income revealed that 20.7% earned below N20,000 monthly, 46.4% earned between N20,000 and N50,000, 26.1% earned between N50,000 and N100,000, and 6.9% earned above N100,000 monthly. The study also revealed that 1.9% of respondents living within a distance of 1-300m earned N20,000–50,000 monthly, while 4.2% in location 601- 900m earned above N100,000. This revealed that the closer the distance to the industries, the lower the income of the people. Since proximity to the place of work enhances productivity, it is not impossible that those who lived in location 1- 300m were dominated by the sawmill workers and could account for the low-income regime.

With regards to the respondent household size., the survey revealed that 30% had between 1 to 3, 51.7% had between 4 to 6, 13% had between 7 to 9 and 5% had more than 10 household members. Further investigation revealed that respondents living in locations 601 to 900m had the highest percentage of household size between 4 to 6 accounting for 31.0%, compared to those who lived in locations 1-300m whose household size was 1 to 3 members, accounting for 23.0%.

Table 2 Socio-Economic Characteristics of Residents in the Study Area

Socio-Economic Characteristic Variables	Respondents Distance							
	1 - 300 m		300 – 600 m		600 – 900 m		Total	
	No	%	No	%	No	%	No	%
Gender								
Male	4	1.5	42	16.9	71	27.2	118	44.8
Female	6	2.3	53	20.3	85	32.6	143	55.2
Total	**10**	**3.8**	**95**	**36.4**	**156**	**59.8**	**261**	**100**
Age								
18-20 years	1	0.4	17	6.5	22	7.7	40	15.3
21-34 years	4	1.5	54	20.7	61	23.4	119	45.6
35-64 years	5	1.9	18	6.9	63	24.1	86	33.0
Above 65 years	0	0	6	2.3	10	3.8	16	6.1
Total	**10**	**3.8**	**95**	**36.4**	**156**	**59.8**	**261**	**100**
Marital Status								
Single	6	2.3	52	19.9	38	14,6	96	36.8
Married	4	1.5	37	14.2	86	33	127	48.7
Divorced	0	0	4	1.5	22	8.4	26	10.0
Widow/widower	0	0	2	0.8	10	3.8	12	4.6
Total	**10**	**3.8**	**95**	**36.4**	**156**	**59.8**	**261**	**100**
Religion								
Christianity	6	2.3	58	22.2	93	35.6	157	60.2
Muslim	4	1.5	35	13.4	58	22.2	97	37.2
Tradition	0	0	1	0.4	5	1.9	6	2.3
Others	0	0	1	0.4	0	0	1	0.4
Total	**10**	**3.8**	**95**	**36.4**	**156**	**59.8**	**261**	**100**
Ethnicity								
Yoruba	9	3.4	76	29.1	122	42.9	207	79.3
Hausa	0	0	6	2.3	6	2.3	12	4.6
Igbo	1	0.4	12	4.6	17	6.5	30	11.5
Others	0	0	1	0.4	11	4.2	12	4.6
Total	**10**	**3.8**	**95**	**36.4**	**156**	**59.8**	**261**	**100**
Educational Background								
None	0	0	11	4.2	23	8.8	34	13
Primary	1	0.4	11	4.2	17	6.5	29	11.1
Secondary	3	1.1	27	10.3	68	26.1	98	37.5
Tertiary	6	2.3	46	17.6	48	18.4	100	38.3
Total	**10**	**3.8**	**95**	**36.4**	**156**	**59.6**	**261**	**100**
Occupation								
Civil Servant	1	0.4	12	4.6	38	14.6	51	19.5
Artisan	1	0.4	35	13.4	48	18.4	84	32.2
Student/Apprentice	5	1.9	33	12.6	17	6.5	55	21.1
Trader	3	1.1	12	4.6	18	6.9	33	12.6
Farmer	0	0	1	0.4	32	12.3	33	12.6
Retired	0	0	2	0.8	3	1.1	5	1.9
Total	**10**	**3.8**	**95**	**36.4**	**156**	**59.8**	**261**	**100**
Monthly Income								
Below 20,000	1	0.4	31	11.9	22	8.4	54	20.7
20,000-50,000	5	1.9	36	13.8	80	30.7	121	46.4
50,000-100,000	4	1.5	21	8	43	16.5	68	26.1
Above 100,000	0	0	7	2.7	11	4.2	18	6.9
Total	**10**	**3.8**	**95**	**36.4**	**156**	**59.8**	**261**	**100**
Household Size								
1-3	6	2.3	28	10.7	45	17.2	79	30.3
4-6	4	1.5	50	19.2	81	31	135	51.7
7-9	0	0	15	5.7	19	7.3	34	13.0
10 and above	0	0	2	0.8	11	4.2	13	5.0
Total	**10**	**3.8**	**95**	**36.4**	**156**	**59.8**	**261**	**100**

(source: Author field survey, 2018)

4.2. Positive Effects of Industry on the Residents in the Study Area

An investigation was conducted on the positive effects of the sawmill industry on the residents of the study area. It revealed that 43.3% of the respondents identified employment generation as comprising 1.9% in location 1-300m, 19.5% in location 301-600m and 21.8% in location 601-900m. Those who regarded infrastructural development as having positive effects accounted for 9.2%, comprising 0.8% in location 1-300m, 1.9% in location 301-600m and 6.5% in location 601- 900m. Wood supply for construction and related use accounted for 29.1%, comprising 0.8% in location 1-300m, 7.7% in location 301-600m and 16.5% in location 601-900m, and provision of wood for domestic use accounted for 18.4%, comprising 3.4% in location 301-600m and 14.9% in location 601-900m. However, respondents in location 1-300m did not benefit from the provision of wood for domestic use. The observed high level of employment generation could attest to the positive effects sawmill industries have on the people in the study area.

Table 3 Positive Impacts of Industry on the Study Area

Location	Perceived Positive Impacts of Industry								Total	
	Employment generation		Infrastructure development		Wood supply		Domestic use			
	No	%	No	%	No	%	No	%	No	%
1-300	5	1.9	2	0.8	2	0.8	0	0	10	3.8
300-600	51	19.5	5	1.9	20	7.7	9	3.4	95	36.4
600-900	57	21.8	17	6.5	43	16.5	39	14.9	156	59.8
Total	**113**	**43.3**	**24**	**9.2**	**76**	**29.1**	**48**	**18.4**	**261**	**100**

(source: Field Survey, 2018)

4.3 Member(s) of Household Working in Sawmilling

In order to ascertain the extent of the effects employment generation had in the area, an investigation was carried out on the members of households working in the sawmilling industry. The study revealed that 45.2% had at least 1 member of their family working at the sawmill industry, comprising 0.8% in location 1 to 300m, 13.8% in location 301 - 600m and 30.7% in location 601 to 900m, 16.9% had between 2 and 3 household members, comprising 1.1% in location 1 to 300m, 7.3% in location 301 - 600m and 8.4% in location 601 to 900 m. Those whose household members were more than 4 accounted for 3.8%, comprising 1.9% both in location 301 - 600m and 601- 900m as against location 1 to 300m who had a high percentage of household members not working in the industry. Less than half of the respondents (34.1%) had no member working at the sawmill. The observed cases of non-members of the respondents' families working in the industries could be attributed to the presence of the university of Osun, whose students are tenants in the houses surveyed. Also, it could be said that the industries had affected individual households in terms of employment generation. This corroborated the work of FORMECU (1992) earlier mentioned in the study.

Table 4 Member(s) of Household Working in Sawmilling

Location	Member(s) of Household Working in Sawmiling								Total	
	1		2-3		More than 4		None			
	No	%	No	%	No	%	No	%	No	%
1-300	5	1.9	2	0.8	2	0.8	0	0	10	3.8
300-600	51	19.5	5	1.9	20	7.7	9	3.4	95	36.4
600-900	57	21.8	17	6.5	43	16.5	39	14.9	156	59.8
Total	**113**	**43.3**	**24**	**9.2**	**76**	**29.1**	**48**	**18.4**	**261**	**100**

(source: Field Survey, 2018)

4.4 Negative Impacts of Industry on the Resident in the Study Area

With reference to the negative effects the sawmill industry had on the residents in the study study area, investigation revealed that 19.2% of the respondents experienced high rent costs, 5% identified transportation costs as the major associated problem, 52.1% identified environmental problems as the major associated negative effects, and 23.1% of the respondents identified all the listed problems as negative effects of sawmilling industries.

Investigation across the selected settlement revealed that 3.1% of the respondents in location 1 to 300m faced more environmental problems like pollution as opposed to other negative effects like high rent and transportation costs, which predominated in other locations. The study also revealed the same trend in locations 301 to 600m and 601 to 900m accounting for 20.7% and 28.4%, respectively. The high cost of rent could therefore be attributed to the presence of industry and student hostels built around the industry. This result was buttressed by a focus group discussion held in the study area in which a participant by name Saidu said, 'the generally observed that environmental problems like noise pollution, air pollution, odour, etc. that we are experiencing form the major negative effect in this area, even though we that are living closer to the industry feel more of the effects than others living farer to the sawmill', these findings thus substantiated earlier assertions by Dosumu and Ajayi (2002) and Boateng and Amedofu (2004) that the farther the distance from the sawmill industry, the lower the environmental complications associated with sawmilling activities.

Table 5 Negative Impacts of Industry on the Study Area

Location	Negative Impacts of Industry								Total	
	High Cost of Rent		Transportation problems		Environmental problems		All of the above			
	No	%	No	%	No	%	No	%	No	%
1-300	0	0	0	0	8	3.1	2	0.8	10	3.8
300-600	25	9.6	5	9.6	54	20.7	11	4.2	95	36.4
600-900	25	9.6	8	3.1	74	28.4	49	18.8	156	59.8
Total	**50**	**19.2**	**12**	**5**	**136**	**52.1**	**62**	**23.8**	**261**	**100**

(source: Field Survey, 2018)

4.5 Forms(s) of Industrial Pollution in Study Area

Recognising environmental problems as negative impacts makes the researcher probe further into the form of industrial pollution experienced in the study area. Findings revealed that the industrial pollution in form of gaseous was experienced by 15.3% of the respondents, about 30.7% experienced solid form of pollution, 21.5% experienced noise pollution while 32.6% experienced all - gaseous solid and noise pollution the industry release.

Table 6 The Perceived Industrial Pollution in the Study Area

Location	Form(s) Of Industrial Pollution								Total	
	Gaseous		Solid		Noise		All of the above			
	No	%	No	%	No	%	No	%	No	%
1-300	1	0.4	5	1.9	1	0.4	3	1.1	10	3.8
300-600	15	5.7	32	12.3	32	12.3	16	6.1	95	36.4
600-900	24	9.2	47	18	19	7.3	66	25.3	156	59.8
Total	**40**	**15.3**	**80**	**30.7**	**56**	**21.5**	**85**	**32.6**	**261**	**100**

(source: Field Survey, 2018)

With respect to location, 1.9 % in location 1 to 300m were affected with the noise from the sawmill industry against other industrial pollutions while 12.3% respondents in location 300 to

600m were affected by solid as a form of industrial pollution which can mostly be associated with poor disposal of sawmill wastes while 25.3% respondents in location 601-900m were affected by the gaseous (smoke), solid (poor disposal of waste), noise pollution against other location. Result from the study revealed that high percentage of industrial pollution is noise emanating from the use of generators and heavy machines used during the sawmilling activities.

4.5 Perceived Environmentally Induced Ailment Caused by Industrial Activities

Further investigation was conducted to determine respondents' perceptions of environmentally-induced ailments caused by industrial activities in the study area. The results revealed that 24.9% of the respondents identified cough, 26.8% identified catarrh, 1.5% identified malaria, and 14.6% identified sleeplessness (insomnia), while 32.2% of the respondents did not attribute any ailment to the sawmilling industrial activities. Variation across the study area revealed that respondents in locations 1 to 300m faced more sleeplessness, accounting for 1.9%, as compared to other locations. Also, in locations 301 to 600m it was more exposed, which accounted for 13.8%, while 32.2% of respondents in locations 601 to 900m were not affected by the sawmill environmental diseases.

This conforms with the findings of studies carried out by Boateng and Amedofu (2004), WHO (2003), and the United States Environmental Protection Agency (EPA) (2007) that problems related to noise pollution, migraine, hearing loss, and high blood pressure, among others, do exist predominantly where the sawmill is located. Studies like Akeredolu (1989), Adelagun, Bberezi, and Akintunde (2012) established that burning sawmill waste can lead to catarrh among sawmillers.

Table 7 Environmentally Induced Diseases Caused by Industrial Activities

Location	Environmentally Induced Diseases Caused by Industrial Activities										Total	
	Cough		Catarrh		Malaria		Sleeplessness		Others			
	No	%	No	%	No	%	No	%	No	%	No	%
1-300	1	0.4	3	1.1	1	0.4	5	1.9	0	0	10	3.8
300-600	35	13.4	36	13.8	3	1.1	9	3.4	12	4.6	95	36.4
600-900	29	11.1	72	27.6	0	0	24	9.2	72	27.6	156	59.8
Total	**65**	**24.9**	**70**	**26.8**	**4**	**1.5**	**38**	**14.6**	**84**	**32.2**	**261**	**100**

(source: Field Survey, 2018)

4.6 Testing of Hypothesis

Moreover, an investigation was made into the significant impact of the Orisumbare sawmill industry on the residents of Ikire. The hypothesis tested says that Orisumbare sawmill activities have no significant impact on the socio-economic lives of the residents in the study area. Using the logistic regression model, the result of the analysis revealed that the monthly income of respondents, the number of household members working at the saw mill, and the positive impact (f = 0.858) have had a significant impact on the residents's socio-economic lives. The model explained 11.8% (Nagelkerke R Square) of the variance in contribution of Orisumbare sawmill activities to residents socio-economic status and correctly classified 66.3% of contributions. Meanwhile, the negative impact of the Orisumbare sawmill (f = 0.526) is insignificant compared to the contribution of Orisumbare sawmill activities to the residents's socio-economic lives.

Table 8 Model Summary

Step	-2 Log Likelihood	Cox & Snell R Square	Nagelkerke R Square
1	298.996	.0.83	.118

Classification Table

	Observed		Predicted		
			Contribution of saw mill activities to residents Socio-Economic		Percentage Correct
			Agreed	Disagreed	
Step 1	Contribution of Orisumbare sawmill activities to residents socio-economic	Agreed	166	15	91.7
		Disagreed	73	7	8.8
	Overall Percentage				**66.3**

a. The cut value is .500

Variables in the equation

		B	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(b)**	**95.0% C.I. for Exp(b)**	
								Lower	Upper
Step 1[a]	Monthly income	-.518	.179	8.265	1	.004	.596	.419	.846
	Member of household working at sawmill complex	-1.442	.683	4.460	1	.035	.258	.062	.902
	Positive impact of sawmill industry	.083	.120	.471	1	.492	.086	.858	1.375
	Number of household member working at sawmill	-.194	.242	.642	1	.423	.424	.513	1.323
	Negative impact of sawmill industry	-.168	.242	.482	1	.488	.845	.526	1.359
	Constant	1.457	1.103	1.744	1	.187	4.294		

5. CONCLUSION

This study concluded that the residents' socio-economic characteristics in different residential zones around the sawmill industry vary. The study examined the impacts of the sawmill industry on residents in Ikire and concluded that the industry serves as a source of employment for the people in the area by providing both direct and indirect employment, which contributed immensely to the socio-economic development of the town. However, the negative impact of the industries in the form of environmental disturbances and stress on the environment was a result of poor forestry practices and management, poor solid waste management, toxic emissions to the air, and noise pollution.

Further, it was concluded that industrial activities have greatly acted as a basis for environmentally-induced ailment in the study area. Therefore, cottage industries should be encouraged, and all waste products should be managed to create wealth for the people in the study area. Also, there is a need for a public enlightenment programme to inform people of the opportunities inherent in the sector. This is because a good number of waste products are wasted away without being harnessed for use.

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URBAN EXPANSION AND LOSS OF WATERSHED OF ELEYELE DAM IN IBADAN, NIGERIA

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ABSTRACT

The study examined human activities contributing to the depletion of the Eleyele watershed. The activities have grown over time due to urban expansion through population growth and land and space requirements, resulting in rapid land use and land cover change. The study sourced both quantitative and qualitative data. A total of 247 pre-tested questionnaires were administered to randomly selected residents in the four communities (Eleyele, Ijokodo, Awotan, and Idi Osan) abutting the Eleyele watershed. In-depth interviews were conducted with the heads of Eleyele Waterworks, the Forestry Department, and the Oyo State Ministry of Agriculture and Natural Resources. We used Remote Sensing and Geographical Information Systems (GIS) to analyze the change in land use and landcover within the watershed from 1987 to 2019. Findings revealed that activities such as fuelwood harvesting, indiscriminate waste dumping, sand excavation, and housing construction, among others, accounted for the watershed encroachment and depletion. Temporal analysis of landcover change between 1987 and 2019 indicated that water bodies decreased from 1.6 km2 to 1.3 km2 in 2019, natural vegetation decreased from 24.8 km2 to 14.9 km2 in 2019, and built-up area increased from 8.9 km2 to 20.1 km2 as of 2019. There is an inverse relationship between urban expansion and the loss of vegetation cover within the watershed. Proposed strategies to secure the watershed and reservoir include the construction of perimeter fencing around the watershed, a public enlightenment campaign, and the reestablishment of protective vegetation in undeveloped areas within the watershed.

Keywords: Eleyele, Geographical information system, Land cover change, Socio-temporal, Watershed Depletion

1. INTRODUCTION

Urbanisation is a global phenomenon with increasing demand for land and housing development, urban agriculture, and the establishment of institutions and industries (Abdullah-Al-Faisal, 2021). The pressure of demand on urban land is resulting in encroachment on urban watersheds primarily meant to protect reservoirs. The encroachment, due to the quest for space, produces a loss of watershed owing to human activities, consequently resulting in natural phenomena such as soil erosion, water pollution, sediment-filled channels, and reservoirs (Nangware et al., 2019). The natural causes include geologic instability, high intensity of rainfall, steep river gradients, shallow soils on steep slopes, and regular bush burning (Igwe and Una, 2019). The anthropogenic activities in the watershed area, such as deforestation, inappropriate farming practices, road and building construction, and mining, are detrimental to watershed conservation.

While we recognize watersheds for their contribution to livelihoods, alternate human activities leading to land cover change have been the main cause of degradation (Hari et al., 2015). Filgueira et al. (2016) often use land cover change as a precautionary indicator of watershed status. sprawl, which

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is a result of a persistent population increase (Turyahabwe et al., 2013), and land demand, which leads to changes in land use, particularly contribute to the effect of urbanization on watersheds. The demand for land in watershed areas has affected the original land use and cover (Akello et al., 2016).

Urban expansion near the margins of watersheds creates a conflict between biodiversity protection and demands for housing and other anthropogenic activities. These conflicts are more frequent and intensive in areas with severe population and development pressures (Simon et al., 2020). Begonade et al., 2020, in response to these problems, designed buffer areas to protect and enhance the conservation of ecologically valuable areas. Unfortunately, the massive pressures from adjacent settlements and land uses have already reduced most forest buffers to a degraded status. The topographical and digital elevation measurement map (DEM) of Eleyele catchments shows that there is a notable lowering of elevations in the catchment area, which has affected the hydrological pattern of the catchment (Olaniyan et al., 2015).

Eleyele Dam is exposed to flooding, notable among which was the flood event that occurred after a heavy rainfall of 187.5mm within 4 to 5 hours on August 26, 2011. This notable flooding occasion was induced by the overflow from Eleyele reservoir, causing the death of over 120 people and causing serious damage to infrastructure, with many bridges collapsing, roads washed away, and substantial property lost (Ede et al., 2019). Shrinking distances between protected areas of Eleyele reservoir and adjourning communities expose the reservoir to threat. The reservoir is consistently exposed to continuous siltation, pollution, and a reduction in the volume of water. Considering these threats to the reservoir and the continuous planless activities within the watershed, periodic assessment and monitoring of the physical development around the reservoir are necessary. Generally, previous research has been conducted on the watershed protection and conservation of the Eleyele watershed without giving adequate attention to the quantification of land cover changes and their associated effects. Consequently, it becomes imperative to assess the spatial and temporal changes in land cover as well as various activities within the watershed and their possible effects on the reservoir with a view to recommending remedial measures.

2. LITERATURE STUDY

This paper will be anchored on the concept of urban land governance. In its most abstract sense, governance is a theoretical concept referring to the actions and processes by which constant practices arise and persist. Governance is a mechanism, an institution, through which citizens articulate their interests, exercise their legal rights, meet their obligations, and mediate their differences (United Nations, 2012). Land governance is concerned with issues of land ownership and tenure. It consists of the policies, processes, and institutions by which decisions about the access to, use of, and control over land are made, implemented, and enforced. It is also about managing and reconciling competing claims on land (Kasimbazi, 2017). The quality of land governance depends on its practical implementation, which is known as land administration (Deininger et al., 2014). Land governance is basically about determining and implementing sustainable land policies (Enemark, 2012). The policies are to encompass the administration, uses, and conservation of land and its biodiversities. This assertion is underscored by the opinion of Aluko (2010) regarding land governance as being nothing more than the policies, processes, and institutions by which land, property, and natural resources are managed. These include decisions on access to land, land rights, land use, and land development. Under the effective rule of law and good governance, physical planning is meant to systematically regulate city development through the preparation of land use developmental plans, master plans, land-use zoning, and layout. Good governance is the fulcrum upon which effective land governance rests. Appiah et al. (2014) observed that access to and use of land is usually constrained by policies and other institutional prohibitions both at the local and national levels. The laid-down developmental plans by the federal, state, or district powers dictate the use of land at the national

level through master plan allocations (Appiah et al., 2014). In the same vein, this concept of land governance becomes imperative in the provision and management of public facilities such as the as the Eleyele dam and the watershed, established in Oyo State in 1942, and in subsequent years.

Eleyele dam and the watershed were established in 1942 to protect the Eleyele reservoir, which is situated on the upper course of the River Ona in Ibadan, south-western Nigeria, within geographical coordinates: latitude 07º 20’00”N – 07º 26’47”N, and longitude 03º 51'50"E – 03º 56'00"E. It falls within the Ido Local Government Area of Oyo State. Eleyele reservoir is situated to the north-west of the Ibadan City centre, bounded by the Eleyele community in the south, Apete in the east, the Awotan community in the north, and Ologuneru in the north-west (Figure 1). The most recently built-up community around the watershed is Idi-osan, in the western direction of the reservoir. The reservoir is surrounded by a variety of woodland margins, beyond which are residential communities on all sides of the reservoir. Eleyele reservoir is a vital resource for fisheries, domestic water supply, and flood control. The reservoir is rapidly degrading due to various anthropogenic activities around its catchments (Olanrewaju et al., 2017).

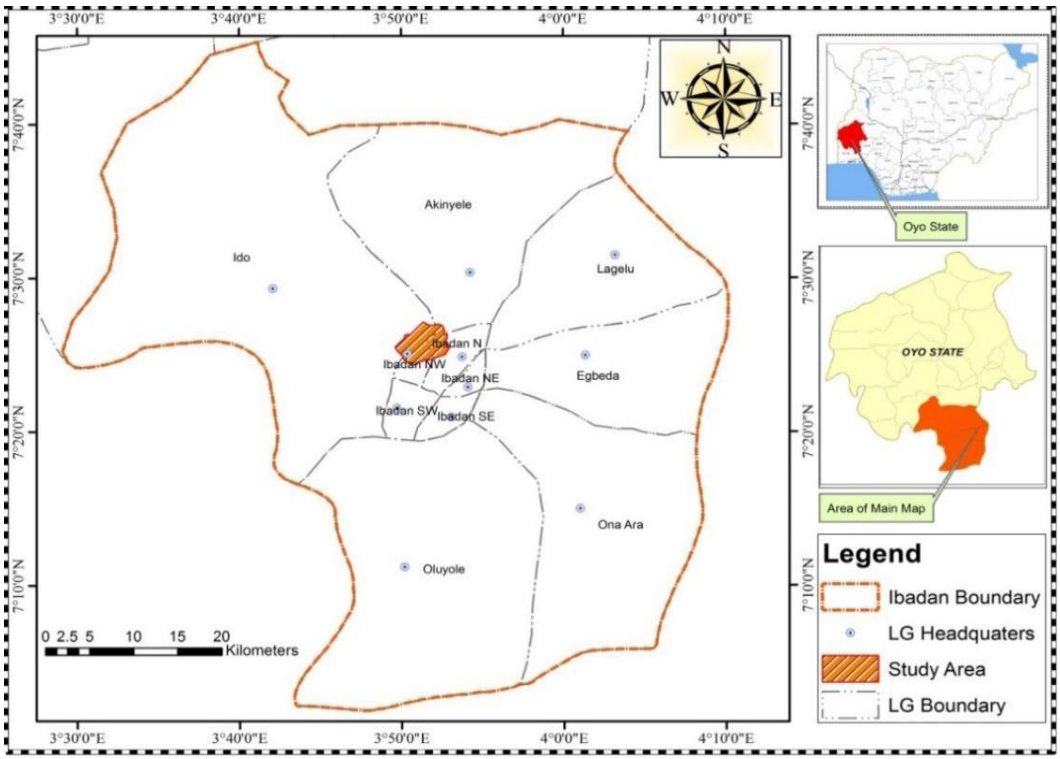

Figure 1 The Study Area in the Context of Ibadan, Oyo Study

The watershed has a fan-shaped shape (Figure 2) with axial lengths of 350 metres, while the magnetic azimuth of the axial line is 180°. The length and width of the watershed are 254m and 520 m, respectively. Another indicator of its shape is the form factor, which is the ratio of the average width to the axial length and which indicates the tendency of a basin towards flooding (Nwa, 1979). Eleyele watershed has mean and median elevations of 88.0m and 87.6 m, respectively.

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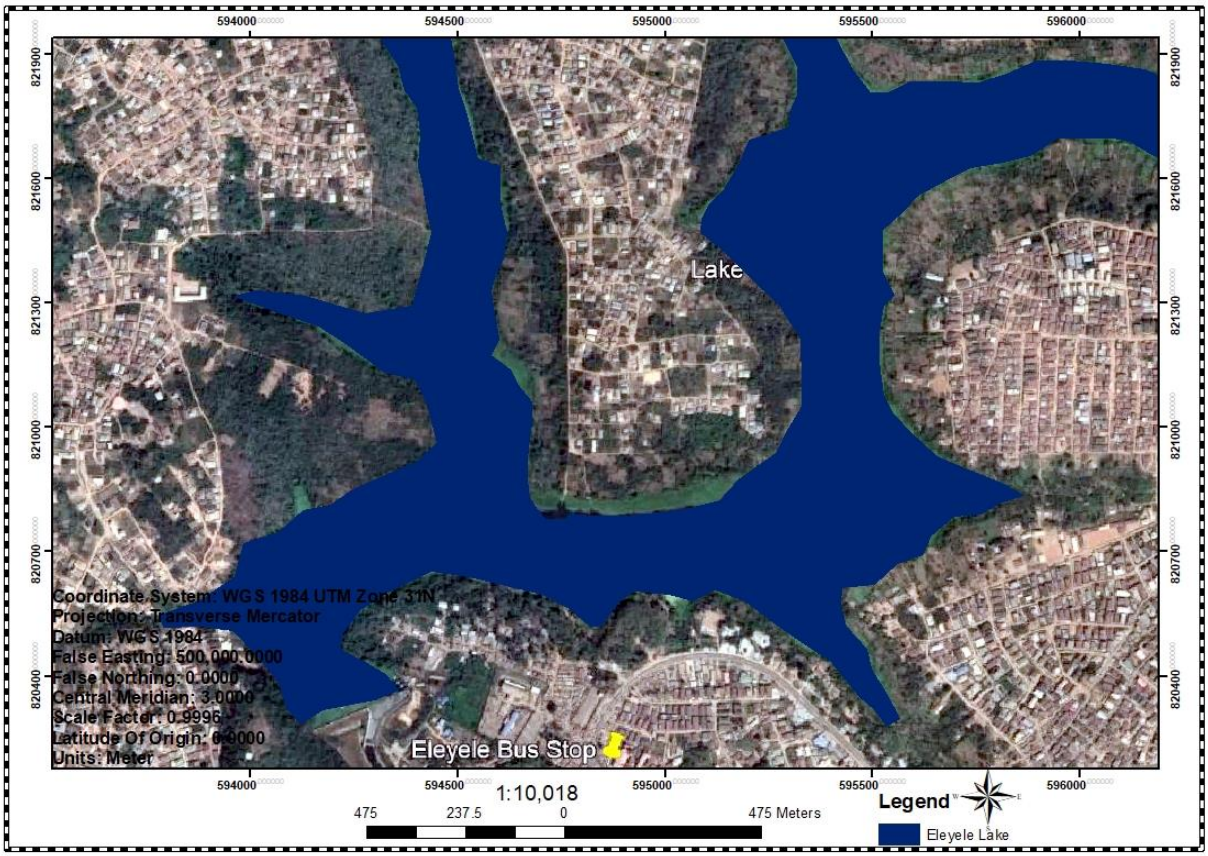

Figure 2 Areal map of Eleyele Watershed and Dam

3. METHODS

This study adopted a mixed methods research strategy where qualitative and quantitative data were collected. We sourced both primary and secondary information. A multistage sampling procedure was adopted in which four communities (Eleyele, Apete, Ijokodo, and Idi-Osan) contiguous to the Eleyele watershed were identified and delineated with the aid of a information system (GIS)-based imagery map. These four communities share boundaries with the Eleyele watershed, and they have expanded overtimes into the watershed area. Provide sufficient detailed methods to allow the work to be reproduced. Methods already published should be indicated by a reference: only relevant modifications should be described.

The study relied on the 1987, 2000, and 2019 satellite imagery maps available for the landcover change analysis. For the purpose of this research, a buffer zone of 2 kilometers radius was delineated around the watershed, and all the existing buildings within the area (12,346 units) were considered as sample frames. The 2-kilometers distance was considered appropriate after diligent ground truthing of the surface slope of the communities where runoff can be emptied into the reservoir was carried out. A total of 247 pre-tested questionnaires were administered to each household head per building in the four communities. The questionnaire contained information about various activities of the people around the watershed as well as the physical developments in the area. The 247 buildings were systematically selected within a two kilometres buffer distance from the reservoir.

Secondary information was sourced from maps, existing literature, the Oyo State Water Corporation, Ibadan, and the Urban Flood Management Agency. Spatial data in the form of satellite imageries of the study area was derived from the American Land-Sat series, where Thematic Mapper (TM) and Enhance Thematic Mapper (ETM) were utilised. Also, the Advanced Space-borne Thermal Emission

and Reflection Radiometer (ASTER) of the Digital Elevation Model of the study area was acquired from the National Aeronautics and Space Administration (NASA) to determine the extent of land use and land cover change in the areas around the watershed between 1987 and 2019. Structured interviews were conducted with the heads of the Eleyele Waterworks and Forestry Department and the Oyo State Ministry of Agriculture and Natural Resources. The information obtained was analysed using both descriptive and inferential statistics.

4. RESULTD AND DISCUSSION

This section presents and discusses the results of the classified Landsat images and field survey conducted at the adjourning residential areas of the Eleyele watershed. Four residential communities (Eleyele, Apete/Awotan, Ijokodo, and Idi-Osan) contiguous to the Eleyele watershed formed the study areas. These communities have expanded over time and encroached into the watershed, occupied by different people of different socioeconomic backgrounds, performing several activities for livelihoods, consequently impacting the watershed. The following subsections provide a detailed explanation of the findings.

4.1. Socio-Economic Attributes of the Residents

Information used for this study was elicited among female and male respondents at a proportion of 66% and 34%, respectively. The major reason for the sex disparity is the availability of women at home during the survey. The majority of the respondents (51.0%) were between the ages of 20 and 39. The highest proportion of the respondents (59.5%) had post-secondary education, while 39.7% and 0.8% had secondary and primary education, respectively. Of all the respondents, 59.1% were married, 36.0% were traders, and 22.3% were civil servants. It is noteworthy to note that 91.1% of the respondents were of the Yoruba tribe, while Igbo was 8.9%.

The study areas (Eleyele, Ijokodo, APete/Awotan, and Idi-osan) are contiguous communities surrounding the Eleyella watershed, which started developing over three decades ago. The duration of some respondents' stay in the communities underscored this revelation. The majority (61.5%) have stayed between 1 and 10 years, 35.2% have lived between 11 and 20 years, and the rest, 3.3%, have lived above 20 years in the area. Information on household size revealed that 81.4% of households have between 6 and 10 people in the family, while the least, 6.1%, had more than 10 people per household. The classification of household size on a community basis showed that Apete/Awotan had the highest (96.4%) share of between 6 and 10 persons per household. Next to Apete/Awotan is Eleyele with 93.3%, while Idi-Osan has the least share (49.1%) in this category. Four categories of residential building types characterise the four communities around the watershed. In all, 59.1% of the total buildings in the communities were self-contained single-story buildings; two-story buildings had 23.9% share; the face-me-fface-you type was 11.3%, while other types were 5.7%. Owner-occupied structures among the buildings were 52.2%, while rented structures were 42.1%. A disaggregation of the findings into communities showed that Eleyele (57.35%), Ijokodo (55.6%), Apete/Awotan (41.1%), and Idi-Osan (52.8%) of the residential buildings were occupied by owners. The information on the number of structures on a plot of land revealed that in all the communities, 76.5% of plots of land have one building structure, 19.8% have two buildings, and 3.6% have three structures.

The age of buildings in the study area indicates when the encroachment on the watershed began. The study discovered that the construction of 8.5% of the buildings started more than 30 years ago. The majority of the buildings (53.8%) were built between 11 and 20 years ago, while 21.9% were built between 21 and 30 years ago. The newest (15.8%) among the buildings were built between 1 and 10

years ago, mostly located in the Idi-Osan area. It is instructive to note that the depletion of the watershed dates back to four decades ago. In addition, 22.7% of the respondents made use of water from the dam during construction, while 15.8% used sand excavated from the watershed for construction purposes. The latter revelation is more prominent in the Eleyele and Apete/Awotan areas. The majority (57.1%) of the building owners bought land from families who claimed to be land owners, while 42.9% bought from private land speculators. As many as 56.7% of the buildings within the watershed had no planning authority approval, which underscores the illegality of most of the building development. This revelation is more pronounced in the Idi-Osan, Apete/Awotan, and Eleyele areas, where 79.2%, 62.5%, and 58.7%, respectively, of the buildings lack approval. The majority (40.9%) of respondents built or rented houses in these communities due to their closeness to their place of work. Others (37.2%) disclosed that land is cheap, while 21.9% considered easy land acquisition.

4.2. Anthropogenic Activities within the Eleyele Watershed

This section provides information on major anthropogenic activities observed in the four main communities (Eleyele, Apete/Awotan, Ijokodo, and Idi-Osan) within the watershed (Table 1). Within the study areas, there are subcommunities or areas where some activities were observed. Eleyele has Mv-Mechanic village, Ww-Waterworks, and Ob-Obokun area; Apete/Awotan comprises Al-Alakuta community and Mo-Morubo community; and Idi Osan has IO-Idi-Osan and OI-Oba Ido communities. The residents rely on these activities to sustain their livelihoods. Urban growth and survival strategies spurred the development of some of these activities. The major economic activities observed include farming, fishing, lumbering, mining, processing industry, block making, mechanic workshops, religious activities, transportation, hunting, herding, and horticulture. These activities were observed around the watershed except for hunting, which is commonly practiced at night by local hunters. Some of these activities, such as farming, tree felling, block making, and building construction, were immensely contributing to watershed land cover change, while others, such as fishing, mining, the gari processing industry, mechanic workshops, refuse dumping, religious gatherings, transportation, herding, and horticulture, were only marginally affecting the reservoir. As of two decades ago, only fishing was allowed by the Oyo state government on a low scale (Adejumo, 2000). Similarly, the government authorised the Kosoko Transport Company to operate inland water transportation on the reservoir less than a decade ago to ease transportation challenges from Eleyele to Idi-osan, Apete/Awotan, and its adjoining communities. Furthermore, 17.8% derive their livelihoods from the watershed environment. More importantly, 20.2% of the respondents from Idi-Osan, Apete/Awotan, and Eleyele have benefited from inland water transportation, while 10.1% practice agriculture and 6.9% do other economic activities such as block industry, horticulture, and gari processing within the watershed. All identified activities are major activities contributing to the degradation of the degradation of the watershed and consequently exposing the reservoir to siltation and high water turbidity, thereby increasing the cost of water purification for public consumption. In addition, some of these activities are largely impacting vegetation cover, leading to continuous loss of vegetation and the disappearance of biodiversity, including wildlife and aquatic animals within the watershed. However, the state government generates revenue through the operations of inland water transportation, while other activities, such as gari processing industries, mechanic workshops, and block-making industries, are paying land rent to the government.

Table 1 Observed Anthropogenic Activities around Eleyele Watershed

Physical and Socioeconomic Activities	Eleyele			Apete/Awotan			Ijokod			Idi-Osan	
	Mv	Ww	Ob	Al	Ce	Ba	Ag	Ol	Mo	IO	OI
Farming	☑	☒	☒	☑	☑	☑	☑	☑	☑	☑	☑
Fishing	☑	☒	☒	☑	☒	☒	☒	☒	☒	☑	☒
Lumbering	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Sand Mining	☒	☒	☒	☑	☒	☒	☑	☒	☒	☒	☒
Processing Industry	☑	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
Construction of Building	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Mechanic Workshop	☑	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
Religious Use	☑	☒	☒	☑	☑	☒	☑	☑	☒	☒	☒
Sourcing of Water	☑	☑	☒	☒	☒	☒	☒	☒	☒	☒	☒
Refuse Dumping	☑	☒	☑	☑	☑	☑	☑	☑	☑	☑	☑
Transportation	☑	☒	☒	☑	☒	☒	☒	☒	☒	☑	☒
Hunting	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
Herding	☒	☒	☒	☒	☒	☑	☑	☒	☒	☒	☒
Horticulture	☑	☒	☒	☑	☒	☒	☒	☑	☒	☒	☒
Fuel-wood Fetching	☑	☒	☒	☑	☒	☒	☑	☒	☒	☑	☑

(source: Field Survey, 2021)

Note : MV- Mechanic Village, Ww – Waterworks area, Ob – Obokun area, Al – Alakuta community, Ce – Cele area, Ba – Babalegba community, Ag – Agbaje area, Ol – Oluseyi community, Mo – Morubo community, IO - Idi-Osan community, OI - Oba Ido community.

Key : ☑ Present
☒ Not present

4.3 Spatio-temporal Analysis of Land Use/Cover Changes in Eleyele Watershed

Eleyele Watershed has over time been converted to different land uses. Field observations revealed that the physical development in the area has come in phases. Peasant farmers primarily inhabited Apete before the establishment of the forest reserve. The most noticeable encroachment began between 1962 and 1978, when houses began to sprawl from Sango towards the Ijokodo area. The establishment of the Polytechnic in Ibadan in 1971 (which serves as a pull factor for some residential and religious buildings) and the construction of the express road linking Sango and Eleyele between 1976 and 1978 were two major factors.

The spate of encroachment on the watershed that increased in the 1970s continued in the 1980s, owing to the city growth across Eleyele Bridge along Ido Road, mostly in the form of residential buildings,

access road development, the construction of petrol filling stations, the establishment of mechanic workshops, and religious buildings, among others. The period between 1995 and 2005 was noted for the increase in the number of residential buildings, petrol filling stations, and market stores. The period from 2006 to 2019 was characterised by physical development along Awotan, Idi-osan, and Oke Eleyele, previously known as protective vegetation. Presently, the watershed contains scanty trees containing some teak (Tectona glandis) and gyminalia (Gmalina aborea) tree species. The construction of residential buildings has destroyed the original teak trees in Agbaje, Oluseyi, Olopomewa, and Ijokodo areas. Lately, the encroachment from Apete, Awotan, and Idi-osan is fast growing towards the reservoir.

4.4 Spatio-temporal Analysis of Land Use/Cover Changes in Eleyele Watershed

The findings showed that the Eleyele watershed has been converted to different land uses over the years, as evident in Figure 3. Four major land cover changes were observed: agricultural lands and bare land; water bodies; natural vegetation; and built-up areas. Using the existing land use of 1987 as the baseline, vegetation was the dominant land cover in the watershed, with a total area of 24.8328 sq km, which is 65.21% of the total area (Table 2). This vegetation consists of teak plants, crop plants, and wild plants. Next to the above land cover are the built-up areas, with a total area of 8.9073 sq km and a share of 23.39% in the watershed. Another common land cover is bare land, which is largely characterised by impervious surfaces and seriously encourages runoff and could be partly responsible for siltation in the reservoir. Its proportion of the watershed was 2.6838 sq km, which is 7.05%, while the water body had the least land cover, with an area of 1.6587 sq km, equivalent to 4.35% of the entire watershed.

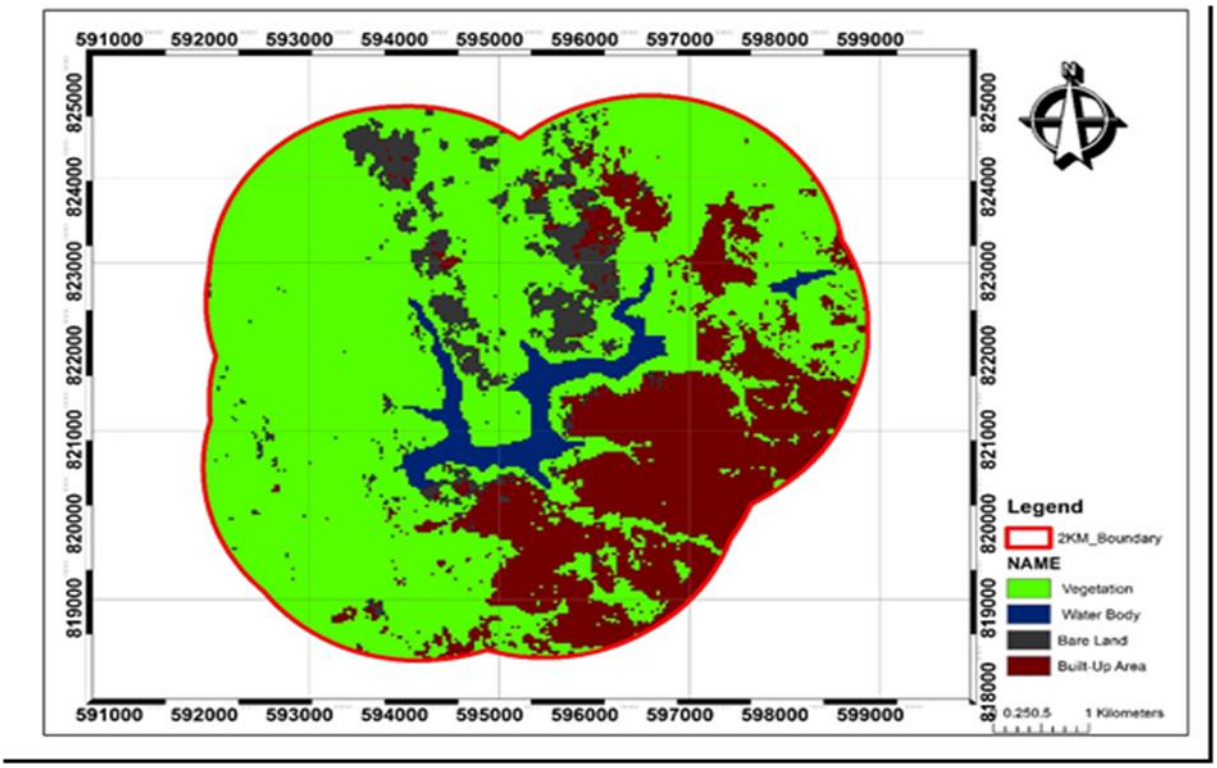

Figure 3 Imagery Map Spatial Land-Use and Cover as at the year 1987
(source: National Aeronautics and Space Administration (NASA))

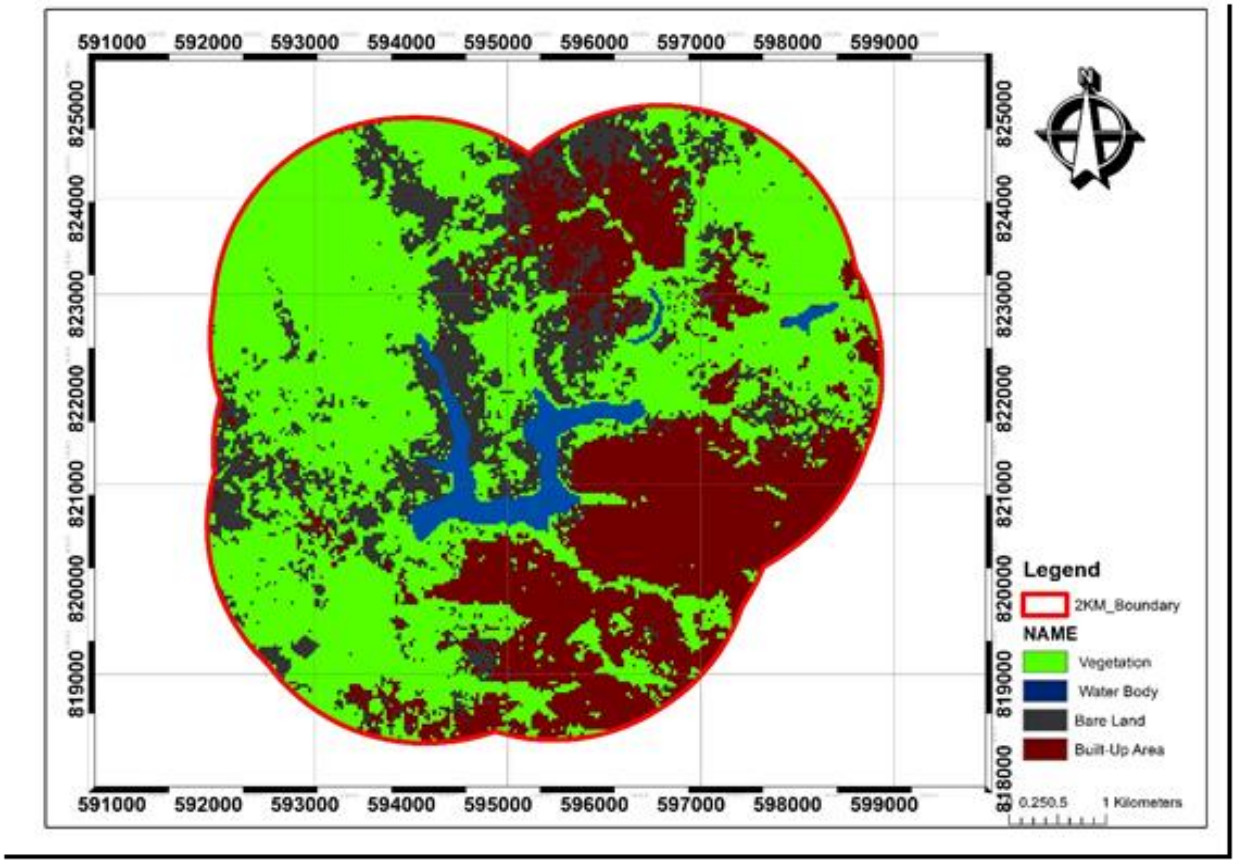

Figure 4 GIS – Imagery Map of Spatial Landuse and Cover as of the year 2000
(source: National Aeronautics and Space Administration (NASA))

Furthermore, a significant increase exists in built-up area in 2019, with a sharp decrease in vegetation cover. The built-up area increased from 10.2825 km2 (27.00%) to 20.1735 km2 (52.97%), while vegetation decreased from 19.6380 km2 (51.57%) to 14.9652 km2 (39.30%), which underscored urban expansion (Table 2). The water body had a slight increase from 1.32 km2 (3.47%) in 2000 to 1.77 km2 (4.65%) in 2019, which is also more than its size in 1987 (1.66 km2; 4.35%). This unanticipated increase in the area of the water body may be caused by August 2011 rainfall, which widened the Eleyele reservoir.

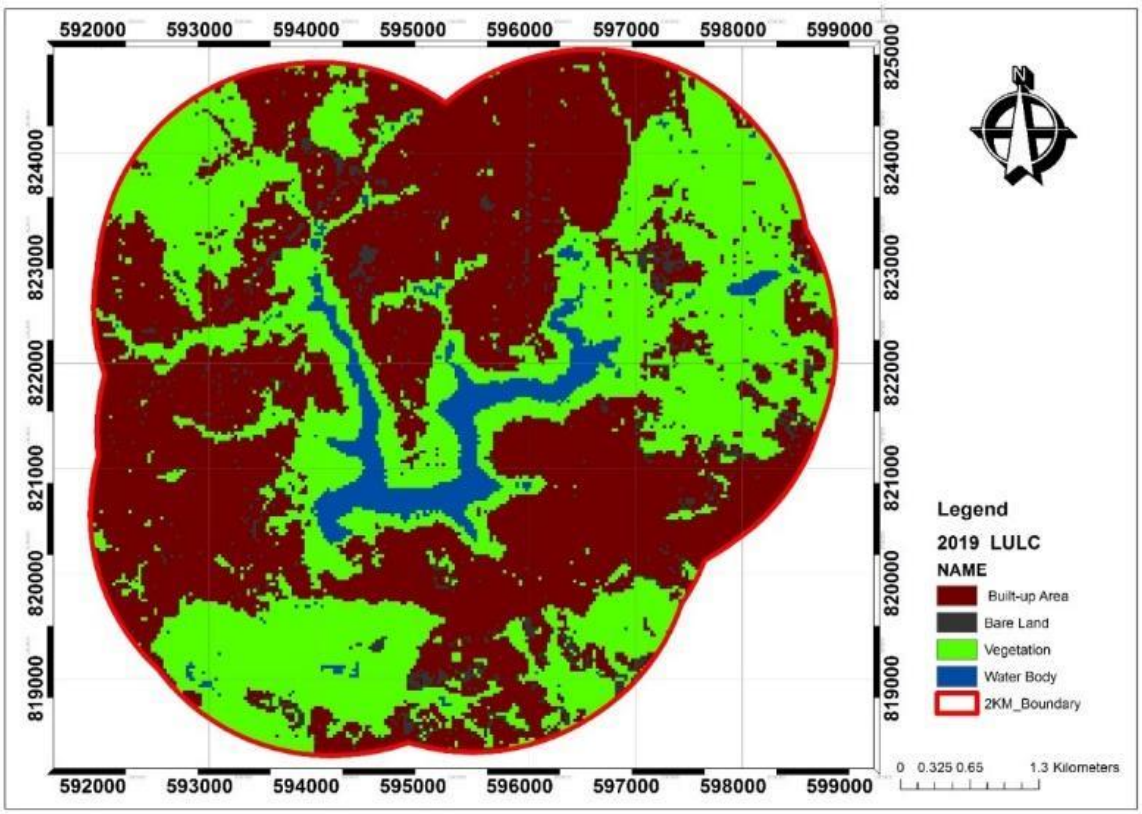

Figure 5 GIS – Imagery Map of Spatial Landuse and Cover as of the year 2019
(source: National Aeronautics and Space Administration (NASA))

Table 2 Summary of Land Use and Land Cover Distribution for Period of 1987, 2000 and 2019

S/N	Land use Type	Area (Sq.km)	%	Area (Sq.km)	%	Area (Sq.km)	%
1.	Vegetation	24.8328	65.21	19.6380	51.57	14.9652	39.30
2.	Built-Up Area	8.9073	23.39	10.2825	27.00	20.1735	52.97
3.	Bare Land	2.6838	7.05	6.8400	19.96	1.1745	3.08
4.	Water Body	1.6587	4.35	1.3221	3.47	1.7694	4.65
	Total	38.0826	100.00	38.0826	100.00	38.0826	100.00

(source: Field Survey, 2021)

4.5 Urban Expansion and Vegetation Loss

Pearson Product Moment Correlation (PPMC) was employed to determine the association between urban expansion and loss of vegetation using $P \geq 0.05$. The results show that the built-up area (urban expansion) has a strong negative correlation with vegetation degradation or depletion within the watershed, with an r-value of -0.904. This implies that there is an inverse relationship between urban expansion and the loss of vegetation cover within the watershed. This means that, as the built-up area increases, there is a decrease in vegetation cover within the watershed. This reveals that vegetation

cover within the watershed has to give way for other land uses such as building and road construction and commercial land uses, among other uses.

		Built-Up Area	Vegetation Area
Built-Up Area	Pearson Correlation	1	-0.904
	Sig. (2-tailed)		.281
	N	3	3
Vegetation Area	Pearson Correlation	-0.904	1
	Sig. (2-tailed)	.281	
	N	3	3

(source: Researcher Computation, 2021)

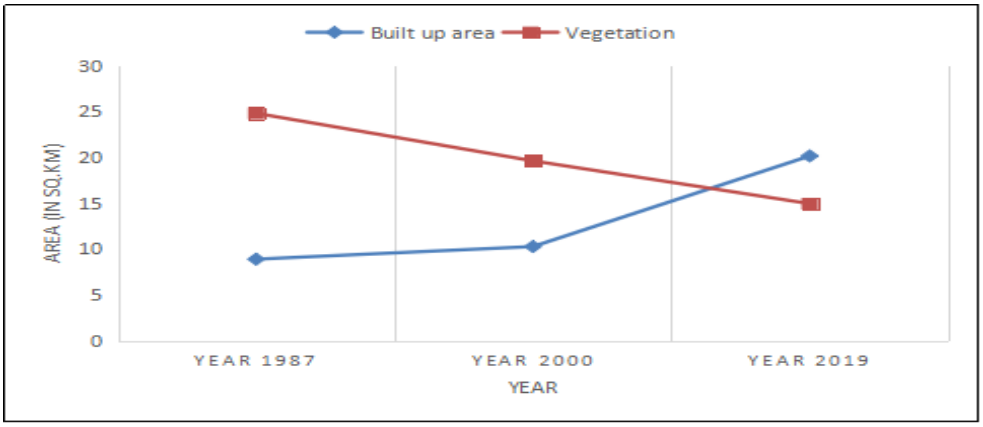

Figure 6 Land Use Change Trend Analysis
(source: Researcher Computation, 2021)

4.6 Effects of Economic Activities on the Watershed

Residents' perceptions of the effects of activities around the watershed were determined to ascertain the severity of the various human activities on the watershed and reservoir at large. The effects of the activities were rated to determine their magnitude, severity, and possible underlined consequences on the environment. More than half of the respondents, 55.1%, were of the opinion that the disappearance of protective vegetation within the watershed has a negative effect on the watershed. It can be asserted that a large proportion (81.8%) of the respondents were aware of the fast depletion of protective vegetation within the watershed. This response is expected due to the increasing urban population, demand for land, and physical developments, all of which result in encroachment on the watershed, largely leading to the fast disappearance of vegetation cover. About 38.9% of respondents identified sand mining as part of the activities within the watershed contributing to watershed degradation. Similarly, respondents remarked that farming activities within the watershed encourage regular bush burning, erosion, flooding, and consequently increasing water pollution. As many as three-quarters (74.9%) of the respondents believe that farming activities encourage bush burning, erosion, and flooding within the watershed. This is evident during land preparation for farming activities when burning is done to dispose of cleared bushes and weeds, thereby exposing the area to erosion and flooding.

Deforestation was identified by the majority (59.5%) as increasing run-off into the reservoir. Analysis of the responses among the communities showed that residents of Idi-osan noticed the effect of deforestation on the watershed to be very severe, while the majority from Ijokodo, Apete/Awotan,

and Eleyele observed that the effect was severe. In addition, the majority of the respondents, 78.7%, 74.6%, 78.6%, and 75.5% from Eleyele, Ijokodo, Apete/Awotan, and Idi-osan, respectively, opined that deforestation has much effect and could increase flooding and rapid loss of vegetation covers.

Table 3 Effect of Deforestation

Severity	Eleyele		Ijokodo		Apete/Awotan		Idi-Osan		Total	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Very severe	-	-	2	3.2	-	-	17	32.1	19	7.7
Severe	59	78.7	38	60.3	44	78.6	6	11.3	147	59.5
Not Severe	16	21.3	19	30.2	12	21.4	18	34.0	65	26.3
Not at all	-	-	4	6.3	-	-	12	22.6	16	6.5
Total	75	100	63	100	56	100	53	100	247	100
Severity of the deforestation										
Much	59	78.7	47	74.6	44	78.6	40	75.5	190	76.9
Not much	16	21.3	16	25.4	12	21.4	13	14.5	57	23.1
Total	**75**	**100**	**63**	**100**	**56**	**100**	**53**	**100**	**247**	**100**

(source: Field Survey, 2021)

4.7 Planning Authority and Development Control

In all only a sum 43.3% of the buildings in the watershed environment were approved by the Physical Planning Authority. As high as 56.7% of the existing buildings had no approval consequently regarded as illegal structures. More importantly, at Idi osan area, 79.2% were not approved while only 20.8% had approval. Similarly, at Eleyele and Apete/ Awotan communities the majority 58.7% and 62.5% of the buildings respectively lack approval. This finding showed the ineffectiveness of the planning authority in charge of the watershed protection and regulation of the physical development. The weakness of the planning authority has given room for encroachment on the watershed.

Table 4 Building Approval

Status of Building	Eleyele		Ijokodo		Apete/Awotan		Idi-Osan		Total	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Approved	31	41.3	44	69.8	21	37.5	11	20.8	107	43.3
No Approval	44	58.7	19	30.2	35	62.5	42	79.2	140	56.7
Total	**75**	**100**	**63**	**100**	**56**	**100**	**53**	**100**	**247**	**100**

(source: Field Survey, 2021)

The Eleyele watershed reserve has gone through severe degradation over time. This is evident in the findings but largely detrimental to the main objective of the watershed, which was meant to prevent the water catchment from erosion and sedimentation on the perimeter of the reservoir. The degradation has been largely caused by weak institutional authority, informal physical development, and the socioeconomic activities of the residents. The plant species that were established were specially chosen because they are very leafy and less deciduous. The larger part of the land area is used for residential, agricultural, and religious purposes but was acquired illegally. The concept of

informality can best describe the situation and nature of development within the Eleyele watershed. The term 'informality' may refer to situations where people live on land to which they have no legal claim or where house construction and land subdivision procedures are performed without the consent of the proper planning authorities and hence do not follow prescribed codes and regulations (Hasan, 1998; Wahab and Agbola, 2017). The manifestation of informality in Nigeria predates the colonial age and is still in existence today. Informality can arise when land is occupied or developed before the area is planned. Most of the pre-colonial settlements fall within this category of informality. The lands and buildings are occupied legally, but there is an absence of development plans to inform the growth and development of the settlements. Such buildings are not formalised because they do not have building plans and are thus considered 'illegal developments', or 'contraventions' (Wahab and Agbola, 2017).

There are debates as to whether or not informality and illegality have the same meaning. Both are informal developments, but with a different degree of legitimacy or legality (Roy, 2005). Urban informality has generally been regarded as illegal (Habitat, 2009). Similarly, economic activities, particularly in urban environments, that fail to comply with legal requirements can be regarded as illegal or informal. Any form of economic activity done in violation of land use regulations within a living environment is regarded as illegal. Urban informality is well-pronounced in casual business activities, which is a common characteristic in the Eleyele watershed. There are proliferations of business activities that are in contravention of the original intention of the Eleyele watershed. The watershed was established to secure the reservoir, but overthe past two decades, there has been mass removal of plant species for economic purposes through informal operators (Adejumo, 2000). The consequence of this activity on the reservoir was not given much attention until the October 2011 flooding in Ibadan happened and the Eleyele dam partly collapsed. The rehabilitation of the dam became a huge and expensive project undertaken by the state government. The persistent encroachment on the watershed has been occasioned by urban expansion, population growth, and increasing demand for land by residents, which continue to threaten the sustainability of the Eleyele Dam. The encroachment on the watershed by all the sampled communities will continue to generate siltation into the reservoir, contaminating the water and increasing the cost of water supply to the residents of Ibadan. In a nutshell, the sustainability of the Eleyele watershed has been compromised as a result of informal activities within the watershed. The main compounding factor is the weak institutional planning mechanism that is supposed to enforce the land use regulation.

5. CONCLUSION RECOMMENDATION

It is evident from these research results that urban expansion has caused depletion and degradation of vegetation cover within the Eleyele watershed over the years. This summation is based on the outcome of data obtained from the United States Geographical Survey (USGS) in the form of images used for the analysis of land use and land cover change within the watershed. The land use regulation is ineffective in allowing physical development without proper checks and authorization from appropriate government agencies. The watershed governance is not firm enough to forestall the use of land areas without a proper permit. These discoveries spell doom for the watershed and endanger the reservoir unless stringent efforts are articulated to secure the watershed. Urban expansion and unguided development have caused significant losses to the Eleyele watershed, and without decisive efforts to salvage the situation, the reservoir will face further threats.

Accordingly, the study recommends that building owners plant a tree per plot to help restore lost vegetative cover within built-up areas of the watershed. Similarly, a total ban is recommended on unauthorised farming activities, fuel wood collection, mechanic workshops, and food processing industries. The establishment of an eco-tourism attraction is another option that the state government may have to consider for promoting and protecting the future of the watershed, generating revenue

for the government, and curbing illegal entry and activities within the watershed. Physical planning interventions, which include adherence to plot size and building ratio, urban consolidation, tree planting, and mitigating excess run-off and siltation in the reservoir, are basic prerequisites for the survival of the watershed.

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CONDITION OF DRAINAGE SYSTEM AND ITS IMPACT ON THE RESIDENTS OF MOWE, OGUN STATE, NIGERIA

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ABSTRACT

This study examines the impacts of drainage infrastructure conditions on Mowe, Ogun State, residents. The study used a quantitative research design, using a systematic random sampling technique to select ten (10) residential estates (three public-owned and seven privately owned) in the study area. In all, 107 residents were sampled using a structured questionnaire. The data collected was analysed using descriptive statistics. Based on the findings of this study, it was evident that the surface drainage system, mainly constructed with sandcrete blocks, was predominant in the study area. The result established that the drainage's minimum height in the study area was 0.1524 metres, while the maximum was 0.889 meters. The analysis shows that the effect of flooding was mostly on properties (68.6%). Moreover, the majority of the residents agreed that drainage infrastructure had an impact on their living conditions. The study underscores the need for policy implications that could aid in the formulation of relevant policies by the Department of Flood and Erosion Control in the Ogun State Ministry of Environment towards improving the residents' quality of life and the environment.

Keywords: Urban planning; Urban infrastructure; Drainage infrastructure; Storm water management

1. INTRODUCTION

Urban environments worldwide face complex interactions between infrastructure and human settlement, especially when dealing with the difficulties presented by drainage systems. The effectiveness and resilience of these systems substantially impact a city's ability to maintain sustainability in the face of rising urbanisation (Zhou, 2014). Globally, the effects of enhanced drainage infrastructure have wide-ranging implications for ecological, economic, and social aspects (Abubakar, 2017).

Improved sanitary infrastructure improves the well-being of inhabitants and promotes economic prospects by increasing the production and use of materials connected to facilities (Jóźwiakowska et al., 2021). Enhancing drainage from an ecological perspective decreases surface water flow, shields soil from erosion, and lowers the risk of flooding in communities (Zhou, 2014). Urban drainage infrastructure encounters significant issues due to insufficient management, inefficient design, and construction approaches (Jemberie et al., 2023).

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The current scenario presents significant health hazards since waterborne illnesses, made worse by floods, continue to be significant (WHO/UNICEF, 2000). Flooding becomes severe when the amount of water runoff exceeds the capacity of the drainage systems, especially in metropolitan areas where the infrastructure is insufficient (Adeloye & Rustum, 2011).

Low- and middle-income countries (L.M.I.C.s), such as Nigeria and Ghana, have distinct issues related to insufficient drainage infrastructure. Nigeria, for example, has the challenge of inadequate drainage infrastructure, which exacerbates environmental risks, particularly in densely populated metropolitan areas (Muhammad & Mustapha, 2017). Furthermore, the imminent consequences of climate change intensify the weaknesses of drainage infrastructure when confronted with increasingly severe storm events, hence aggravating floods in several areas (Pachauri et al., 2014). The fast development of urban centres has increased drainage-related problems, resulting in inadequate sanitation (Olukanni et al., 2014). The increase in flooding incidents in communities around Mowe, Ogun State, Nigeria, highlights the need to assess how the quality of drainage infrastructure affects the well-being of inhabitants (David et al., 2014). This study, therefore, aims to assess the impacts of drainage infrastructure conditions on Mowe's residents.

2. LITERATURE REVIEW

Drainage infrastructure and its impact on urban living conditions have garnered attention in academic discourse globally, addressing multifaceted aspects of urban development and environmental sustainability. A thorough review of the existing literature reveals various dimensions and considerations concerning drainage systems and their implications. Zhou (2014) posits that the operational efficiency of drainage systems is a crucial determinant of a city's sustainability amidst rapid urbanisation. Additionally, Pachauri et al. (2014) emphasise the intensified flood risks and associated challenges of climate change, emphasising the need for robust drainage infrastructure. de Oliveira et al. (2022) investigated the correlation between urban drainage flaws and their consequential effects on critical infrastructure in Brazil. Their study highlighted the significance of water dynamics in guiding land use and emphasised the critical role of preserving water spaces in addressing developing urban threats, notably floods. The findings highlighted the crucial function of the drainage system as an initial structuring driver in supporting sustainable urban planning, ensuring resilience against flooding, and maintaining environmental stability.

In Nigeria, Echendu (2020) and Okopi (2022) highlight the prevalence of surface drainage systems and the challenges posed by inadequate infrastructure in regions like Nigeria, affecting living conditions and contributing to flooding incidents. Umar et al. (2019) conducted a comprehensive investigation into the repercussions of inadequate maintenance of drainage systems in Damaturu town, Yobe State, Nigeria. The study emphasises that neglecting the upkeep of drainage systems leads to multifaceted challenges. Firstly, it engenders a distortion of the aesthetic environment, negatively impacting the visual appeal of the surroundings. Secondly, it triggers excessive soil erosion, exacerbating environmental degradation.

Moreover, inadequately maintained drainage infrastructure contributes to the deterioration of essential infrastructure like roads and residential houses. These circumstances culminate in unsanitary conditions for residents residing in affected neighbourhoods. The resultant environmental degradation further compounds the challenges, posing considerable threats to the community's well-being and quality of life.

Yerima (2017) conducted a comprehensive study to assess the challenges associated with the drainage system in Minna, Nigeria. The findings revealed a substantial inadequacy in the town's drainage infrastructure. Contributing factors included poor sanitary practices, improper housing layouts, obstructed drainage pathways, and indiscriminate dumping of refuse. These issues collectively amplified erosion problems and significantly contributed to the prevalence of flooding in the area.

Studies such as Bassey et al. (2020) and Olukanni et al. (2014) elucidate the adverse effects of poor drainage infrastructure on residents' well-being. They cite increased health risks, property damage, and reduced quality of life as consequences of inadequate drainage systems in L.M.I.C.s.

Furthermore, Alejo (2018) investigated the causes of the drainage system and the immediate causes of the poor drainage system in Akure. The finding reveals that certain low-lying areas in Akure needed better-designed drainage systems owing to insufficient technical expertise. Additionally, indiscriminate disposal of debris into these drainage systems exacerbated the challenges. The study highlighted that these inadequacies in the drainage infrastructure were the primary cause of recurrent flooding, significant damage to environmental infrastructure, and loss of lives and property within the study area. However, despite existing literature addressing various facets of drainage infrastructure, research gaps persist, particularly concerning precise interventions and sustainable solutions. These gaps drive the necessity for localised studies like the current research in Mowe, Ogun State, Nigeria, aiming to provide specific insights and interventions tailored to the community's needs.

3. MATERIALS AND METHODS

3.1 The Study Area

This study was conducted in Mowe, Ogun State, in South Western Nigeria, located at 6° 57' N, 3° 30' E; it lies along the Lagos-Ibadan Expressway and is located 29 kilometres (18 miles) from Lagos and 512 kilometres (318 miles) southwest of Abuja, the nation's capital (Figures 1 and 2). Mowe is a linear settlement town on the Lagos-Ibadan Expressway. Its local government, Obafemi Owode, shares common boundaries with other local government areas such as Odeda, Sagamu, Ikenne, Ifo, and other local government areas in Lagos and Oyo State. More gradually, Mowe is becoming a bustling new-found town, attracting all and sundry. It is among the adjoining towns on the Ketu-Berger axis of Lagos. It has a population of 228,851, according to the 2006 national population census. It covers an area of 1,410 km2 with a landmass of 104,787.07 hectares, primarily dominated by agricultural activities. Mowe has over 14 communities, including Abule-Egba, Loburo, Ogunrun, Adesan, Daluwon, and Orunkole. Major districts and areas located at the centre of Mowe include the M.F.M. region, Desh hub, Redeemer's College of Technology and Management, N.N.P.C., Oak Faith Pharmaceutical Resources, Mowe Main Market, etc.

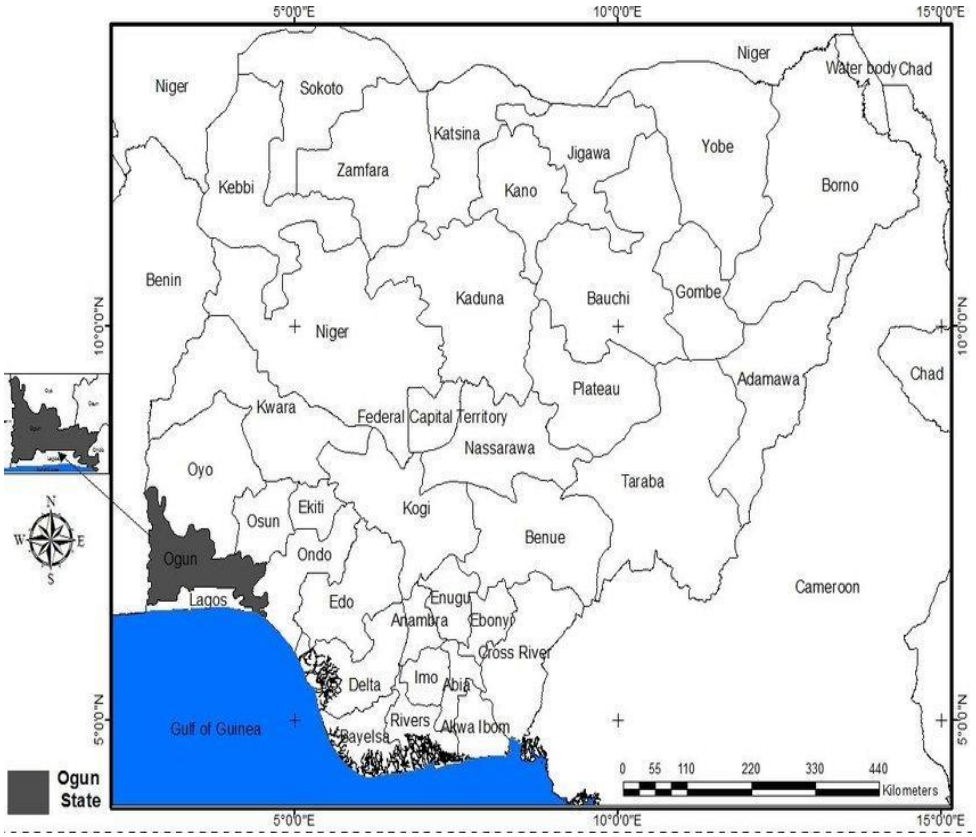

Figure 1 Map of Ogun within Nigeria Context
Source: Chaitkin, Layiwola, &Popoola (2018)

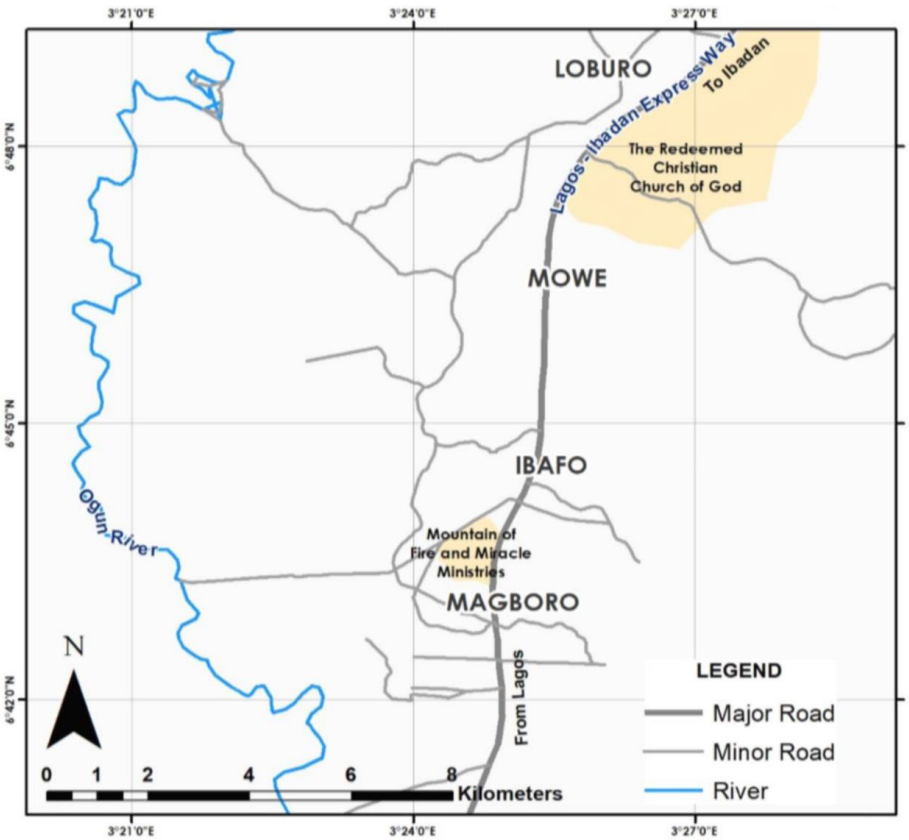

Figure 2a Map of Mowe within the Ogun State Context
Source: Jimoh (2020)

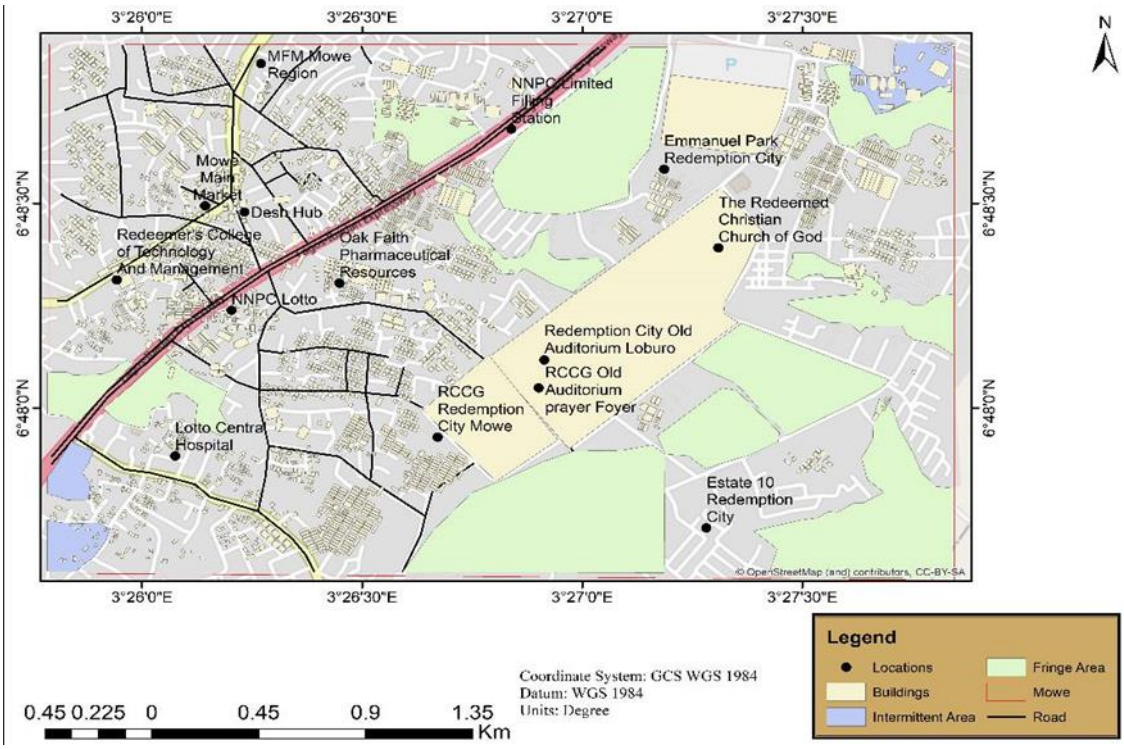

Figure 2b Spatial Distribution of District in Mowe
Source: Google Earth Imagery & Authors' Fieldwork (2022)

3.2 Method of Data Collection and Analysis

This study employed primary and secondary data sources to ensure a comprehensive and nuanced understanding of the subject matter. Primary data collection methods included a structured questionnaire, direct observation, and personal interviews. These methodologies aimed to evaluate the existing drainage infrastructure, assess its physical condition, and understand its impact on residents within the study area. The questionnaire administration focused on eliciting responses related to the types, conditions, and effects of drainage systems.

In addition to primary data, secondary data on the spatial locations of residential estates in the study area were gathered from Google Earth (see Figure 2b) and the Ogun State Ministry of Housing and Urban Development. Nineteen residential estates were identified in the study, comprising fourteen privately owned and five publicly owned estates (Table 1). The selection of a sample size of ten estates (three public and seven private) was determined using a systematic random sampling technique (Table 2). Four thousand two hundred sixty buildings were identified in the study area, and a sample size of 2.5%, totaling 107 houses, was used.

The collected data underwent analysis using descriptive statistical tests. The goals of these studies were to describe the different types and features of drainage infrastructures, find common problems with bad drainage systems, find out how drainage infrastructure affects people's living conditions, and look at what's being done in the study area to deal with these effects.

Furthermore, we incorporated an observational checklist into the data collection instruments to comprehensively capture and document the observed attributes and conditions of drainage infrastructure across the sampled estates.

Table 1 List of Resident Estate in Mowe

S/N	Top-rated Residential Estate	Residential Estate	No. Of Buildings
1.	Public Owned	Dolphin Estate	352
2.		National Theatre & National Troupe Estate	408
3.		Treasure Island Estate	516
4.		Dreamland Estate	257
5.		Palm View Estate	423
6.	Private Owned	Blessed Estate	408
7.		Hallelujah Estate	476
8.		Golden Heritage Estate	364
9.		Ifetedo Estate	358
10.		Masters Golden Estate	420
11.		Noah Pavilion (Jubilee) Estate	426
12.		Richard & Jacob Court Estate	502
13.		Happylife Estate	164
14.		Golden Estate	201
15.		Premier Garden City Estate	102
16.		Prime Estate 1& 2	350
17.		Queens Park Estate	315
18.		Royal Estate	250
19.		Smart Homes, Mowe	150
		Total	**6,442**

(source: Google Earth Imagery & Authors' Fieldwork, 2023)

Table 2 Sampled Residential Estates in Mowe

S/N	Residential Estate	No. Of Buildings	Sample Size at 2.55%
1.	Dolphin Estate	352	9
2.	National Theatre & National Troupe Estate	408	10
3.	Treasure Island Estate	516	13
4.	Richard & Jacob Court Estate	502	13
5.	Blessed Estate	408	10
6.	Hallelujah Estate	476	12
7.	Golden Heritage Estate	364	9
8.	Ifetedo Estate	358	9
9.	Masters Golden Estate	450	11
10.	Noah Pavilion (Jubilee) Estate	426	11
	Total	**4,260**	**107**

(source: Google Earth Imagery & Authors' Fieldwork, 2023)

4. RESEARCH FINDINGS

4.1 Types of Drainage Infrastructures in Selected Housing Estates

This section analyses the diverse drainage infrastructural configurations observed within chosen housing estates. Table 3 shows that only surface drainage was present in the study area. The observed dominance of this drainage type might be connected to the relatively low cost of construction and maintenance typically found in Nigerian urban residential areas. In addition, similar results were reported by Muhammad & Mustapha (2017) while appraising drainage conditions along selected areas and roadways in Sokoto Metropolis in Northern Nigeria. To further identify the nature of the drainage infrastructure in the study area, the material used in constructing the drainage was observed, as well as the drainage's height, weight, and physical condition.

Table 3 also establishes concrete blocks as the primary material for constructing drainage infrastructure across the study area. This inference suggests a consistent preference for concrete blocks as construction material for drainage infrastructure throughout the surveyed estates, indicating its affordability and availability within the region. This aligns with the findings of Echendu (2021), highlighting the cost-efficient approach of the material. This construction practice is, however, worrisome, owing to the limited ability of the concrete bock to resist lateral and live loads surrounding it, thereby making it structurally unfit for drainage.

We expect drainages to purposefully respond to the prevailing environmental conditions in the area for effective urban stormwater management. Findings from this study show that about three-quarters of the drainages were of medium depth (0.5m and below), corroborating previous studies affirming that urban drainage design in Calabar and Maiduguri, urban areas of Nigeria, had narrowed widths (Musa et al., 2019; Ndoma et al., 2020). The studies also revealed that the drainage was narrow and shallow, contributing to frequent floods.

Furthermore, we evaluated the condition of the drainage infrastructure within the study area using direct observation methods. The assessment of the drainage infrastructures revealed noteworthy variations in their condition across the surveyed estates. About half of the drainages were adequate, indicating that these infrastructures were deemed adequate for their intended purpose (see Table 3). In contrast, Hallelujah, Ifetedo, and Richard & Jacobs Estates exhibited signs of dilapidation, signifying a state of disrepair and requiring attention to restore functionality. Furthermore, we found partial obstruction of the drainage infrastructure in Dolphin Estate and complete blockage of the drainage infrastructure in Golden Heritage Estate, both of which significantly hindered adequate water flow.

Table 3 Attributes of Drainage Infrastructure in the Study Area

Estate	Type		Material		Height		Width		Condition			
	Surface	Sub-Surface	Concrete-Block	No Finishing	< 0.5m	> 0.5m	< 0.2m	> 0.2m	Adequate	Dilapidated	Partially Blocked	Fully Blocked
Blessed Estate	*	---	*		*		*		*			
Dolphin Estate	*	---	*			*		*			*	
Golden Heritage	*	---	*		*			*				*
Hallelujah Estate	*	---	*		*			*		*		
Ifetedo Estate	*	---	*		*					*		
Masters Estate	*	---		*	*		*	*	*			
N.T.N.T.S Estate	*	---	*			*		*	*			
(Jubilee) Estate	*	---	*		*			*	*			
R. J. Estate	*	---	*		*			*		*		
T.I. Estate	*	---	*		*		*		*			

(source: Authors' Survey, 2023)

An overarching observation suggests that only 50% of the surveyed drainage infrastructures meet the adequacy criteria. This condition raises concerns about the potential challenges residents in these areas may face. Urgent attention and remedial measures are imperative to mitigate potential issues related to drainage inefficiency, emphasising the critical role of infrastructure maintenance and development for the community's well-being. Findings by Okopi (2022) corroborate these observations, highlighting deficiencies in drainage services and infrastructure within residential estates in Kano, Nigeria, which resonates with the inadequacies identified in this study.

Figure 3: An adequate drainage Blessed Estate

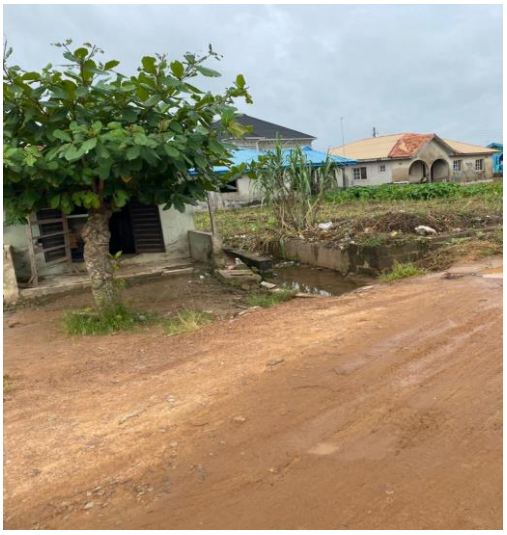

Figure 4: Dilapidated drainage in Treasure Island Estate

Figure 5: Partially blocked drainage in Dolphin Estate

Figure 6: An entirely blocked drainage in Hallelujah Estate

4.2 Flood Occurrence in the Study Area

This section reports respondents' accounts of floods within the study area, shedding light on the frequency, extent, and impact of the inundation events. The analysis outcomes, as delineated in Table 4, underscore the prevalent perception among respondents regarding the susceptibility of the study area to flood occurrences. A substantial majority, comprising 65.4% of respondents, acknowledged the inherent vulnerability of the area to floods, while 34.6% expressed dissent on this matter. Notably, specific housing estates emerged as prone to flood occurrences, with National Theatre & National Troupe Staff Estate leading at 80.0%, Golden Heritage Estate at 77.8%, and Noah's Pavilion (Jubilee) Estate at 72.7%. Dolphin Estate (55.6%) and Masters Golden Estate (54.5%) were deemed averagely prone based on residents' responses.

Table 4 Flood Occurrence in the Study Area

Selected Estates	Flood Occurence		Total (%)
	Yes (%)	No (%)	
Blessed Estate	6 (60)	4 (40)	10 (100)
Dolphin Estate	5 (55.6)	4 (44.4)	9 (100)
Golden Estate	7 (77.8)	2 (22.2)	9 (100)
Hallelujah Estate	8 (66.7)	4 (33.3)	12 (100)
Ifetedo Estate	6 (66.7)	3 (45.5)	9 (100)
Masters Golden Estate	6 (54.5)	5 (45.4)	11 (100)
National Theatre & National Troupe Staff Estate	8 (80.0)	2 (20.0)	10 (100)
Noah's Pavillion (Jubilee) Estate	8 (72.7)	3 (27.3)	11 (100)
Richard & Jacob Estate	8 (61.5)	5 (38.5)	13 (100)
Treasure Island Estate	8 (61.5)	5 (38.5)	13 (100)
Total	**70 (65.4)**	**37 (34.6)**	**107 (100)**

(source: Authors' Survey, 2023)

4.3 Effect of Flood Occurrence in the Study Area

The multifaceted impact of flood occurrences within the study area is presented here. The results indicate an intricate narrative of the environment and resident's repercussions.

Table 5 Effect of Flood Occurrence in the Study Area

Selected Estates	Effect of Flood Occurence			Total (%)
	Crops and plants (%)	Hunman lives (%)	Properties (%)	
Blessed Estate	1 (16.7)	1 (16.7)	4 (66.6.)	6 (100)
Dolphin Estate	1 (20)	0 (0.0)	4 (80.0)	5 (100)
Golden Estate	2 (28.6)	0 (0.0)	5 (71.4))	7 (100)
Hallelujah Estate	1 (12.5)	1 (12.5)	6 (75.0)	8 (100)
Ifetedo Estate	2 (33.3)	1 (16.7)	3 (50.0)	6 (100)
Masters Golden Estate	2 (33.3)	0 (0.0)	4 (66.7)	6 (100)
National Theatre & National Troupe Staff Estate	2 (25.0)	1 (12.5)	5 (62.5)	8 (100)
Noah's Pavillion (Jubilee) Estate	1(12.5)	2 (25.0)	5 (62.5)	8 (100)
Richard & Jacob Estate	1 (12.5)	1 (12.5)	6 (75.0)	8 (100)
Treasure Island Estate	1 (12.5)	1 (12.5)	6 (75.0)	8 (100)
Total	**14 (20.0)**	**8 (11.4)**	**48 (68.6)**	**70 (100)**

(source: Authors' Survey, 2023)

Further exploration concentrated on the respondents who affirmed the occurrence of floods in the study area, probing into the consequential effects. As displayed in Table 5, the findings reveal that the predominant impact, as indicated by 68.6% of respondents, was on properties. Additionally, 20.0% of respondents noted the impact on crops and plants, while 11.4% highlighted the effects on human lives. This discernment aligns with the overarching conclusion that residents' properties disproportionately bear the primary brunt of flood occurrences in the study area. This aligns with Echendu's (2020) assertions, affirming that floods substantially damage properties and assets.

4.4 Period of Flood Occurrence

The temporal dimension of flood occurrences within the study area is reported in this section. The research sought to ascertain the periods during which floods are most prevalent. The results of this analysis, as presented in Table 6, illuminate significant insights into the timing and frequency of flood incidents. The findings highlight that, according to 65.4% of respondents, the period of flood occurrences spans from April to October. Conversely, 34.6% of respondents held the perspective that there was no occurrence of floods throughout the year. Understanding the temporal distribution of flood events is pivotal for devising effective mitigation and preparedness strategies.

Table 6 Period of Flood Occurrence in the Study Area

Selected Estates	Flood Occurence		Total (%)
	Between April and October (%)	No Occurrence (%)	
Blessed Estate	6 (60)	4 (40)	10 (100)
Dolphin Estate	5 (55.6)	4 (44.4)	9 (100)
Golden Estate	7 (77.8)	2 (22.2)	9 (100)
Hallelujah Estate	8 (66.7)	4 (33.3)	12 (100)
Ifetedo Estate	6 (66.7)	3 (33.3)	9 (100)
Masters Golden Estate	6 (54.5)	5 (45.5)	11 (100)
National Theatre & National Troupe Staff Estate	8 (80.0)	2 (20.0)	10 (100)
Noah's Pavillion (Jubilee) Estate	8 (72.7))	3 (27.3)	11 (100)
Richard & Jacob Estate	8 (61.5)	5 (38.5)	13 (100)
Treasure Island Estate	8 (61.5)	5 (38.5)	13 (100)
Total	**70 (65.4)**	**37 (34.6)**	**107 (100)**

(source: Authors' Survey, 2023)

This analysis provides a foundational understanding of the periods during which the study area is more susceptible to flood occurrences, offering valuable information for informed urban planning and disaster management initiatives.

4.5 Impacts of Drainage Infrastructures on Residents' Living Conditions in Selected Housing Estate

This section discusses the ramifications of drainage infrastructure on the living conditions of residents within the chosen housing estates. Through an in-depth analysis, the study seeks to unravel the multifaceted impacts stemming from the effectiveness or inadequacy of drainage systems. The study, examining the impact of drainage infrastructure on residents' living conditions in selected housing estates in Mowe, presents a comprehensive analysis based on residents' responses. The aggregated results indicate that most respondents (3.99) agreed that drainage infrastructure notably impacts living conditions.

Overall, respondents agreed (3.99) that drainage infrastructure had various impacts, including poor road conditions (4.44), increased flooding risks (4.43), poor health conditions (4.19), poor hygiene (4.15), adverse impacts of flooding (4.15), high levels of pollution (4.09), poor waste management habits (4.01), and a dirty environment (3.92). Additionally, respondents acknowledged impacts like regular building collapse (3.32) and lack of potable water (3.23).

Table 7 Period of Flood Occurrence in the Study Area

Impacts of Drainage Infrastructures	BE	DE	GH	HE	IE	MG	NT	NP	RJ	TI	Mowe
Poor health condition	4.20	4.22	5.00	3.75	4.30	3.61	4.02	5.00	3.74	4.10	**4.19**
Poor waste management habits	4.00	4.11	3.77	4.08	3.84	4.15	4.10	3.78	4.02	4.24	**4.01**
Adverse impacts of flooding	4.00	4.11	4.44	3.50	4.46	4.00	4.01	4.43	4.41	4.13	**4.15**
Increased flooding risks	3.70	3.66	5.00	5.00	4.00	3.61	4.76	4.98	4.98	4.60	**4.43**
Regular building collapse	2.60	2.55	2.66	2.91	4.37	2.53	4.15	4.16	2.90	4.35	**3.32**
Poor road condition	3.80	3.88	4.88	4.63	4.00	3.76	4.92	4.97	4.79	4.80	**4.44**
Dirty environment	3.60	3.66	4.72	3.66	3.53	3.61	3.61	4.76	3.62	4.42	**3.92**
High level of pollution	3.90	4.00	4.71	3.66	4.15	3.92	4.01	4.75	3.61	4.14	**4.09**
Poor hygiene	4.20	4.22	3.77	4.08	4.00	4.15	4.12	4.93	4.04	4.01	**4.15**
Lack of potable water	3.40	3.22	4.00	3.58	2.76	2.84	3.12	4.11	2.53	2.70	**3.23**
Total	**3.74**	**3.76**	**4.30**	**3.89**	**3.94**	**3.62**	**4.08**	**4.59**	**3.86**	**4.15**	**3.99**

*Note: **BE** = Blessed Estate; **DE** = Dolphin Estate; **GH** = Golden Heritage Estate; **HE** = Hallelujah Estate; **IE** = Ifetedo Estate; **MG** = Master Golden Esatte; **NT** = National Theatre & National Troupe Staff Estate; **NP** = Noah Pavilion (Jubilee) Estate; **RJ** = Richard & Jacob Court Estate; **TI** = Treasure Island Estate.*

Bassey et al. (2020) also reported similar findings, highlighting the significant contribution of poor drainage systems to recurrent flooding occurrences and subsequently diminishing the quality of living conditions for individuals in affected areas. This aligns with the observed impacts of drainage infrastructure inadequacies on residents' living conditions in the present study, underscoring the multi-dimensional effects of drainage system deficiencies.

Table 8 Efforts to Manage Negative Impacts of Drainage Infrastructure

Efforts	BE	DE	GH	HE	IE	MG	NT	NP	RJ	TI	Mowe
Drainage systems should be cleared with shovels regularly	3.70	3.73	2.55	3.59	3.62	3.72	3.00	3.97	2.52	3.51	**3.39**
Avoid dropping waste materials into drainage channels	3.80	3.77	3.55	2.50	3.82	3.70	3.88	2.75	3.60	3.46	**3.48**
Construction of closed drainages to prevent the dropping of wastes	3.80	3.77	3.78	3.75	3.85	3.85	3.79	3.75	3.72	3.83	**3.79**
Environmental education on impacts of indiscriminate waste disposal	2.80	2.77	2.66	3.00	3.42	2.61	3.29	3.26	2.62	3.01	**2.94**
Aggregated Mean	**3.43**	**3.51**	**3.14**	**3.21**	**3.68**	**3.47**	**3.49**	**3.42**	**3.12**	**3.45**	**3.40**

*Note: **BE** = Blessed Estate; **DE** = Dolphin Estate; **GH** = Golden Heritage Estate; **HE** = Hallelujah Estate; **IE** = Ifetedo Estate; **MG** = Master Golden Esatte; **NT** = National Theatre & National Troupe Staff Estate; **NP** = Noah Pavilion (Jubilee) Estate; **RJ** = Richard & Jacob Court Estate; **TI** = Treasure Island Estate.*

The results reveal a comprehensive deployment of various efforts in the study area to mitigate the adverse effects of drainage infrastructure challenges. While the intensity of these efforts varies across estates, several joint initiatives emerged as predominant strategies adopted by residents. For instance, in Blessed, Dolphin, Golden Heritage, Ifetedo, and Richard and Jacob Estates, respondents

consistently ranked "Construction of closed drainages to prevent dropping of wastes" (3.80; 3.77; 3.78; 3.85; 3.72) and "Avoid dropping waste materials into drainage channels" (3.80; 3.77; 3.55; 3.82; 3.66) as the most prevalent efforts to mitigate the effects of drainage infrastructure. In summary, the findings affirm the presence of numerous initiatives aimed at reducing or eliminating the adverse effects of drainage infrastructure in the study area.

4.6 Discussion of Findings

The examination of drainage infrastructure is a pivotal facet within urban settings, profoundly influencing habitability and resilience. A notable result is the exclusive presence of surface drainage through notable observation. This dominance likely stems from cost considerations prevalent in Nigerian urban residential areas. The relatively lower cost of constructing and maintaining surface drainage systems often makes them a preferred choice, aligning with the resource constraints typical in such settings. The prevalence of surface drainage systems observed throughout the study area aligns with the findings of Echendu (2021), highlighting the prevalence of surface drainage systems as more commonplace in Nigeria. The extensive use of concrete blocks as the primary material for drainage infrastructure further reinforces the cost-efficient approach prevalent in the study area. The direct assessment of drainage infrastructure conditions revealed a spectrum across the surveyed estates. While approximately half were deemed adequate, significant disparities were evident. The overarching observation that only 50% of surveyed drainage infrastructures meet adequacy criteria raises concerns. This discrepancy poses potential resident challenges, necessitating immediate attention and remedial measures. Okopi (2022) reported similar findings in his study, noting inadequate drainage services and infrastructure within residential estates in Kano, Nigeria.

The analysis indicates a prevalent perception among respondents regarding the susceptibility of the study area to floods, with a notable majority (65.4%) acknowledging this vulnerability. Among respondents affirming flood occurrences, the primary impact, cited by 68.6%, was on properties, underscoring the substantial toll on residents' assets. While effects on crops and human lives were also noted, the emphasis on property damage reveals the dire consequences for residents' livelihoods and assets. This finding resonates with the observations of Echendu (2020), who similarly emphasises that floods damage properties and assets, including productive assets, aligning with the identified impact on residents' assets in the current study. Insights into the timing of flood occurrences, spanning April to October, according to 65.4% of respondents, provide a crucial understanding of the seasonal pattern. The findings highlight the necessity for context-specific interventions addressing property vulnerabilities and aligning flood mitigation efforts with the identified temporal patterns.

The study further highlights a strong consensus among respondents regarding the significant impact of drainage infrastructure on residents' living conditions. The aggregated responses affirm the multifaceted nature of these impacts, encompassing various aspects such as road conditions, flooding risks, health, hygiene, environmental quality, waste management, and infrastructure stability. The specific impacts identified by respondents, notably poor road conditions, increased flooding risks, and health-related concerns, elucidate the breadth of challenges arising from drainage inadequacies. Additionally, issues like pollution, waste management, and infrastructure stability underscore the complexity and multifaceted nature of the problems faced by residents. Bassey et al. (2020) highlighted similar findings in their study, noting that poor drainage systems significantly contributed to recurrent flooding occurrences, consequently diminishing the quality of living conditions for individuals in those areas. This finding resonates with the observed impact of drainage infrastructure inadequacies on residents' living conditions in the current study, further emphasising the widespread implications of poor drainage systems across urbanised regions in Nigeria.

Findings from the study also underscore diverse mitigation efforts deployed across surveyed estates to address drainage-related challenges. Joint initiatives, notably the construction of closed drainages

and waste management practices, emerged as predominant strategies adopted by residents across several estates. However, the intensity and focus of these efforts varied among different housing estates, reflecting contextualised approaches to tackle specific drainage-related issues. Overall, the study underscores the critical need for proactive measures and targeted interventions to enhance drainage infrastructure, alleviate its adverse effects on residents' living conditions, and fortify community resilience against the challenges of inadequate drainage systems in urban settings.

This section discusses the initiatives and measures implemented to mitigate the adverse effects of drainage infrastructure challenges in the study area. Through a detailed analysis, the study aims to discern the various strategies employed by residents, local authorities, and other stakeholders to address and manage the negative impacts on the community.

5. CONCLUSION AND RECOMMENDATION

This study was conducted to comprehensively assess the impacts of drainage infrastructure on residents of Mowe, Ogun State. The findings elucidate critical insights into the state of drainage systems and their direct implications for the community's living conditions. These insights serve as a clarion call for policymakers in the Department of Flood and Erosion Control to mitigate the area's prevalent poor sanitation practices and conditions.

The identified challenges related to drainage infrastructure, including inadequate maintenance, design inefficiencies, and sanitation issues, significantly impact residents' well-being. Consequently, urgent and proactive measures are imperative to address these challenges and improve the living conditions of Mowe's residents. Based on the findings of the study, the following recommendations were made:

a. Regular Maintenance and Inspection: in collaboration with the Ogun State Environmental Protection Agency, Local Government Councils should enforce routine maintenance schedules for drainage systems. Periodic inspections and cleaning are imperative to prevent blockages and ensure sustained functionality.
b. Green Infrastructure Implementation: Collaboration between Urban Planning Departments and Ogun State Environmental Protection Agency can introduce nature-based solutions alongside traditional drainage systems. Initiatives like rain gardens and permeable pavements can augment drainage capacity, enhance water quality, and improve urban aesthetics.
c. Capacity Building and Training: Stakeholders like Community Development Associations should conduct training programs for local technicians and residents. Equipping them with drainage system maintenance and repair skills can ensure timely responses to issues and promote community engagement.
d. Multi-Stakeholder Collaboration: A joint effort involving Government bodies, N.G.O.s, and Private Sector entities is crucial in developing holistic strategies for drainage infrastructure. Collaborative initiatives can pool resources, expertise, and ideas for more effective and sustainable solutions.
e. Incentivising Responsible Practices: In partnership with the Ogun State Environmental Protection Agency, Local Government Councils can devise incentive programs for communities adhering to responsible waste disposal and proactive drainage management. Such incentives can foster community participation and reinforce positive behaviours.
f. Legal Framework and Enforcement: Government agencies must strengthen existing regulations or introduce new ones to enforce proper waste disposal and drainage infrastructure

management. A robust legal framework ensures compliance with environmental standads and serves as a deterrent against negligence.

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PARTNERSHIP AND COALITION EFFORTS FOR COMMUNITY-BASED RESEARCH: TOWARDS A LIVEABLE URBAN AND RURAL SETTLEMENT IN KWAZULU-NATAL, SOUTH AFRICA

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ABSTRACT

This paper examines the role of community partnerships and coalitions in the intricate and constantly evolving dynamics of communities in KwaZulu-Natal, South Africa. Various aspects of the community context, such as socioeconomic conditions, geography, environmental factors, demographics, community politics, and cultural norms, often influence these community partnerships and coalitions. This study adopted the Community Coalition Action Theory as an organisational framework to examine the efforts of coalitions and partnerships in community-based research. The research applied a mixed-methods approach. This included a survey and individual interviews within the research organisation responsible for multiple community-based projects in rural and urban areas of KwaZulu-Natal, as well as in-depth interviews with project beneficiaries and senior government officials. An interpretative phenomenological analysis was applied to explore how contextual factors impacted partnership and coalition formation. Our results highlight the importance of community-based partnerships and coalitions in facilitating effective research initiatives that improve the quality of life in rural and urban communities. This study emphasises the importance of incorporating community voices into decision-making processes that impact their lives. Our findings provide insights into how partnership and coalition efforts shape the research process and why they are crucial for community-based research. The results also identify the types of partnerships required for successful research, community planning, and intervention implementation, along with the foundational principles and components needed for effective partnering. This paper advocates for strategic collaborations between academic institutions, government departments, and local communities. It highlights the critical influence of community politics, historical context, and cultural values during the research implementation phase. These findings offer guidance for improving approaches to community-based research implementation, ensuring that research comprehensively addresses the needs of rural and urban communities.

Keywords: Capacity building; Community coalitions; Community development; Community-based research; Partnership

1. INTRODUCTION

Community engagement is a fundamental aspect of research and project implementation, particularly in regions with diverse and unique social, economic, and cultural dynamics like KwaZulu-Natal, South Africa. KwaZulu-Natal is known for its rich cultural heritage, but it also faces various challenges, including health disparities, poverty, and high unemployment. To address these issues effectively, community engagement is crucial in fostering collaboration, partnerships, and coalitions in understanding local needs and promoting sustainable development.

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Given their diverse and intricate pedigrees, partnerships and coalitions for research can be described as flexible and organised partnerships between individuals from different organisations, groups, or constituencies. These alliances are formed with the intention of collaborating towards a shared research objective (Chavis, 1995). In addition, during the post-apartheid era, community-based initiatives have emerged as the foundation of interventions aimed at addressing and redressing complex community challenges. These initiatives aim to mobilise communities, develop comprehensive strategies, garner broader support from society, and enhance the influence of community institutions in research, policies, and practical interventions.

Government departments in KwaZulu-Natal have funded various community-based research projects to better understand issues affecting communities, particularly those in rural and urban areas. According to P. Elson et al. (2018), CBR aims to achieve (directly or indirectly) community justice and change. However, despite the efforts, there is still a significant gap between rural and urban communities, especially in partnering and coalition building for research. Discourse on partnership and coalition effectiveness remains in the early stages of development and understanding in South Africa; however, several factors seem to be associated with effective processes, outcomes, and impacts. Process evaluation research has found numerous partnerships and coalition characteristics and factors, such as formalisation, planning, inclusiveness, leadership, resources, and ongoing professional development, are essential to partnership and coalition effectiveness (Berger, 2013).

This paper unpacks the underlying issues associated with the urban-rural divide and the best approaches to implementing community-based research projects. Furthermore, the paper demonstrates the power of collaboration and coalition efforts within and between researchers, communities, and government departments to enhance community living conditions and well-being, particularly those in rural areas. As a result, it provides a solution that can fill the gap as to why partnering is essential to community-based research and what type of partner is required to facilitate research, community planning, and intervention implementation. As a result, this study contributes to a practice-based knowledge of how the community environment influences partnerships and coalitions for community-based research.

2. LITERATURE STUDY

2.1. Historical Background of South Africa

Systems of colonisation, oppression, and institutionalised racism are still prevalent in South Africa and have resulted in distinct social and economic structures, increasing rural poverty and inequalities (Du Toit, 2017). Therefore, the urban-rural divide is as clear as day and night in South Africa, which might appear to be overstated; however, it contains elements of truth that cannot be ignored. The South Africans gained independence in 1994, and 28 years later, rural communities continue to struggle to fulfill basic requirements including water and sanitation, appropriate transportation, technical infrastructure, education, etc. In addition, there is little or no sign of change as these communities face different unethical, political, and cultural challenges that impede their progress and place them far behind those living in urban areas (Moloto, 2020). According to Omodan et al. (2019), South Africa’s transformation prioritises equal opportunities for all; however, there is a significant divide between rural and urban communities. Therefore, the urban-rural divide necessitates the need to bridge the gap and address the traps of colonisation, and colonial struggles manifested through the unequal allocation of goods and services.

Likewise, research organisations and the South African government departments have worked together to implement community-based research initiatives aimed at comprehending community requirements and enhancing living conditions. As a result, community-based research has been recognised as critical in generating great understanding and knowledge that can guide policies and programs to reduce health, social, and socio-economic inequalities (Flicker & Savan, 2006). This was

supported by Strand et al. (2003) when articulating that community-based research, in its broadest sense, is to engage in social action to bring about societal change and social fairness.

The biggest questions are:

1. Why are there such disparities between urban and rural communities when so much community-based research has been conducted?
2. Whose policy agendas are being implemented if rural communities continue to struggle with no evidence of positive change?

South African leaders ignore the ramifications of exclusion and how they are inextricably linked to imperial history. These leaders tend to forget that the primary aim of colonialism was to regulate people's wealth and distribution, including political dictatorship and normalising the abnormalities (Canagarajah, 2022; Wa Thiong'o, 1998). Therefore, this suggests that decolonising the mind is crucial to implementing new strategies and adopting new approaches that encourage equality for all people, whether they live in rural or urban communities. This paper focuses on the community-based research partnerships and coalitions necessary to implement effective and responsive community-based research projects to bridge the gap between rural and urban communities. In addition, put forward new approaches that can be used to ensure that the community's voices are heard and considered in decision-making regarding issues affecting their lives. Furthermore, the chapter explains the significance of partnering in community-based research, the types of partnering required to facilitate research, community planning, and intervention implementation, and the principles and components of community-based research partnering necessary to facilitate impact.

2.2. Rural-Urban Disparities and Dynamics

The concepts of rural and urban have different connotations. Urban areas can range from formal to informal, and rural areas vary greatly depending on size and population, agricultural levels, and social governance structures (Collinson et al., 2007). During the apartheid era, many black people were forcibly relocated from white urban areas to live in black Bantustans (Atkinson, 2014). Therefore, the general concept of an urban area refers to a town or city that is self-contained, heavily populated, and established with a range of shops and services (Scott et al., 2007). The South African government's mandate is to provide essential services to all South African citizens, regardless of whether they live in urban or rural communities (Constitution, 1996). South Africa is considered a developing nation. Nonetheless, the country shows several aspects of a developed country, including a high level of urbanisation and infrastructure. However, South Africa's development shows a high degree of unequal distribution between urban and rural populations, and there is a significant social and economic disparity.

Consequently, this gap has a noticeable effect on service delivery (Rodseth et al., 2020). Further, Booysen (2003) concurs that in South Africa, urban-rural disparities persist, demonstrating discriminatory behaviour against marginalised communities, particularly those living in rural areas. As a result, there is an urgent need to improve the poor and unresponsive service delivery to rural communities, which rely on local government departments to provide quality services to improve their living conditions (Moloto et al., 2020). Rural communities have fewer social and economic options than people in urban areas. In addition, rural communities face numerous challenges, including a low level of employment and income. Likewise, strong leadership is essential in rural development to ensure that policies are developed and implemented in a manner that includes everyone, not just urban communities (Moloto et al., 2020).

Table 1 Traditional Stereotypical Differences between Urban and Rural Populations

No	Dimension	Urban	Rural
1.	Economy	Secondary and tertiary sector dominant	Primary industry sector and supporting activities dominant
2.	Employment	Manufacturing, construction, administration and services	Agriculture, forestry and other primary industry occupations
3.	Education	Higher than national averages	Lower than national averages
4.	Services Accessibility	High	Low
5.	Information Accessibility	High	Low
6.	Sense of Community	Low	High
7.	Demography	Low fertility and mortality	High fertility and mortality
8.	Political Views	Liberal and radical elements more strongly represented	Conservative, resistance to change

(source: Scott et al, 2007:4)

Table 1 summarises the significant differences between urban and rural areas that relate to the concept of an urban-rural divide. Rural and urban disparities have been two sides of the same coin for more than a century due to rural exclusion and government dysfunction, resulting in unequal distribution of development (Du Toit, 2017). Therefore, the rural-urban divide is linked to the social, economic, cultural, and political relationships that exist between urban and rural communities (Ndabeni, 2016).

2.3 Participatory Action Research

The foundations of participatory action research (PAR) can be traced back to Paulo Freire, who argued that critical reflection was necessary for individual and social change (McIntyre, 2002). In addition, PAR entails cooperation between a community with lived experience related to social issues and academics who bring appropriate expertise, skills, networks, and resources (Cornish et al., 2023). Likewise, PAR is a philosophical approach to research that recognises the significance of examining the needs of individuals and groups while including all the stakeholders in the entire research process (Vollman & Jackson, 2020). Therefore, PAR is:

> *"an approach characterised by the active participation of researchers and participants in the co-construction of knowledge; the promotion of self-and critical awareness that leads to individual, collective, and or social change; and an emphasis in a co-learning process where researcher and participants plan, implement, and establish a process for disseminating information gathered in a research-a recursive process that involves an adaptable spiral system that includes questioning a particular issue, reflecting upon and investigating the issue, developing an action plan, and implementing and refining the said plan"(*McIntyre, 2007:5).

However, Dedding et al. (2021) indicate that PAR is based on a lengthy and multidisciplinary history, with each discipline contributing to the development of its perception of what it is. Conversely, this approach decreases inequities and aims to create a more comprehensive and accurate representation of the research subjects, facilitating a learning platform for reflecting diverse perspectives and expectations and directly involving the communities (Abma et al., 2019). Therefore, PAR focuses on responsive approaches to addressing real-world issues and improving marginalised communities' living conditions (Springett et al., 2016). This approach is also aimed at empowering communities through social transformation while embracing human rights (Kemmis, 2008).

2.4 Community and Community-Based Research

Researchers from various disciplines use the term community in different ways. Therefore, understanding the community paradigm is necessary to guide policy, support, and development and to build inclusive communities (Cobigo et al., 2016). According to Blackshaw (2010), a functional community comprises well-connected, interdependent groups that share responsibility, identify and address problems, and foster their well-being. Conversely, community-based research (CBR) "is a collaborative approach that equitably involves all partners in the research process and recognises the unique strengths each brings" (Israel et al., 1998:177).

Likewise, CBR has progressively become an essential and critical strength of community practice. In addition, it is an important technique in which the research team collaborates closely with other practitioners and members of the community to improve understanding of a particular phenomenon and increase positive results (Ragavan et al., 2019). According to Chan and Farrington (2018), CBR projects are regularly underpinned by a collaborative aspect that emphasises the balance of powers, connections, and research design collaborative technique. Therefore, in CBR, fundamental principles include partnership guiding the process and bringing together researchers and the community to explore and create prospects for social change (Roche, 2008). P. Elson et al. (2018) defined CBR as a type of participatory research that addresses people's needs by combining community-based organisations' practical knowledge and know-how with researchers and academic institutions. Strand (2000) asserts that CBR is the research approach where community members and researchers collaborate in the design and execution of research targeted at addressing the needs identified by the community. However, in practice, community participation is relatively limited.

Similarly, the fundamental principles of CBR primarily focus on partnerships and collaborations that recognise different types of knowledge founded on the idea of inclusivity (Roche, 2008). Bischoff and Jany (2018) articulate that CBR can be defined as an engaging and transformative approach, especially in promoting social inclusion. In addition, CBR is a research approach that prioritises community partnerships, is rooted in collaboration and inclusiveness, and focuses on change (K. J. Strand et al., 2003). For this reason, researchers need to acquire facilitation techniques to ensure that the CBR is conducted meaningfully to benefit the communities (Zuber-Skerritt et al., 2020).

2.5 Capacity Building

"Community capacity building is not an evolutionary process, but rather it can be planned to achieve an effective community development goal" (Sail & Abu-Samah, 2010:68). Therefore, community capacity building refers to the influence of a community's engagement, abilities, and skills that may be utilised to develop community strengths, address community challenges, and improve their living conditions (Merino & de los Ríos Carmenado, 2012). According to Sail and Abu-Samah (2010), community capacity building relates to the process of strengthening members of the community's existing abilities to manage their own lives and control and influence development. In addition, community capacity building leads to people's empowerment, and empowered communities result in improved quality of life and well-being. Likewise, community building nurtures individual and political participation, enhances community structures, improves economic systems, increases skills opportunities, sustains youth and families, grows the sense of community and awareness, and encourages belongingness (Nowell & Boyd, 2010; Townley et al., 2011). Craig (2007) concurs that community development is an effective strategy for promoting economic improvement and social change in communities. However, it can be exploited to satisfy political interests.

Moreover, Sail and Abu-Samah (2010) articulate that the primary goal of community capacity building is to enhance and expand the community's existing abilities. This concept implies that we can positively influence and develop community knowledge to enhance living conditions. However,

community capacity-building programmes are difficult to execute as local community capacity differs by knowledge and culture. Therefore, to encourage community members to participate and contribute to developing programs that benefit the entire community, a high level of community engagement is required (Mohd Noh et al., 2020).

2.6 Community Action Coalition Theory (CACT)

This paper adopted community action coalition theory (CACT) to promote community agreement among individuals and organisations to address community challenges and bridge the urban-rural divide. Community action coalition theory encourages long-term engagement among partners before and beyond the execution of a project to assure coalition creation, continuity, and effective partnership synergy, as well as community development to bring about community change (Butterfoss & Kegler, 2002). Community coalitions consist of disparate organisations aligning to accomplish a shared objective. Therefore, community coalitions or partnerships include advocacy, engagement, learning, empowerment, service delivery, capacity building, social action, and change (Benz et al., 2011). Likewise, community coalitions provide effective change, represent the community's heterogeneity, and involve professionals and community organisations (Butterfoss, 2007). According to Kegler et al. (2010:1), community coalition action theory comprises several “practice-tested” propositions that encapsulate what is experimentally known and what might be accepted regarding how community coalitions may result in improved social outcomes. As a result, it promotes community coalitions and the structure of collaborative organisational relationships that engage in advocacy and learning as effective mechanisms for policy change (Taliep et al., 2020).

3. METHODOLOGY

This paper utilised a sequential explanatory mixed methodology anchored through an interpretative phenomenological analysis (IPA), which allowed for a more comprehensive and in-depth understanding of the phenomena. Adopting this method of analysis, the study explored the lived experiences of participants, delving deeply into the subjective, personal, and meaning-making aspects of human experiences, including the individual’s internal processes and the external factors that shape their experiences, such as social, cultural, and environmental influences.

As a result, the paper began with the quantitative, followed by a qualitative phase in which the qualitative results were used to contextualise and strengthen the quantitative findings (Creswell & Plano Clark, 2011). Using a mixed methodology allowed the researchers to understand the subject matter better. Furthermore, this rigorous approach addressed broader questions and provided insight that a single method would have overlooked (Creswell & Plano Clark, 2011; Hoover & Krishnamurti, 2010). Therefore, combining quantitative and qualitative data was necessary to capture the wide range of diverse viewpoints necessary to answer our research questions. In addition, using more than one data collection method allowed the researchers to conquer research limitations and capitalise on the benefits of using quantitative and qualitative data. The researchers simultaneously collected, analyzed, and interpreted both quantitative and qualitative data (Creswell & Plano Clark, 2011). The quantitative approach was based on deductive reasoning, while the qualitative method relied on inductive reasoning. Using deductive and inductive methods enabled this study to comprehend different aspects of the same phenomenon. Participants working in the research organisation (N = 51) completed the survey, and 10 participated in the in-depth interviews.

We conducted four focus group discussions, in which forty-two individuals, including community stakeholders, participated. Finally, five in-depth individual interviews were conducted with the government departments’ stakeholders to understand their role in funding community-based research

and how it addresses rural-urban disparities to improve the communities' living conditions. With the participants' permission, focus group discussions and in-depth interviews were recorded. We supplemented these recordings with field notes and existing literature to gain a profound understanding of the crucial discourses that required emphasis. Quantitative data was entered, coded, and analysed using the statistical package, SPSS 28. We transcribed and thematically coded the qualitative data using NVIVO 12. This paper used pseudonyms to enable participants to maintain their privacy and confidentiality.

4. FINDINGS AND DISCUSSION

4.1 Findings

Findings from a research organisation in South Africa (Ngcobo, 2023). "Community participation has made an enormous contribution to the implementation of research projects."

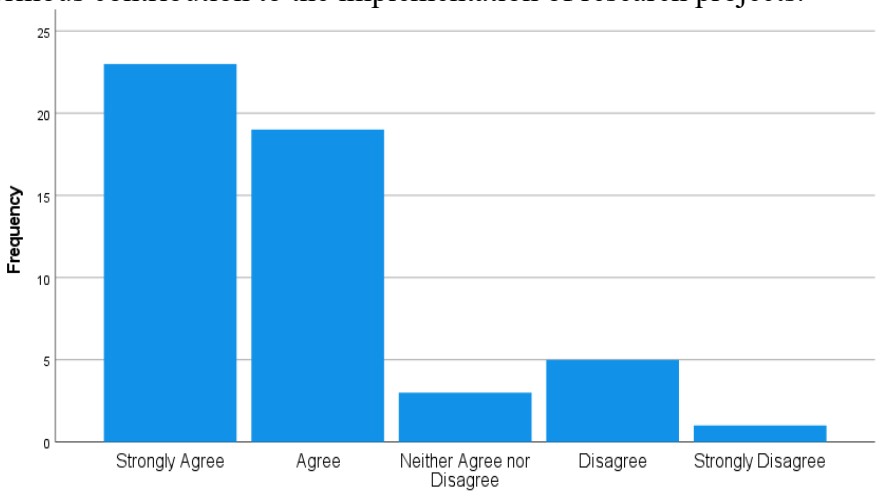

Figure 1 Community-Participation has Made an Enormous Contribution to the Implementation of Research Projects

The result indicates that 45,1% strongly agreed that community participation had enormously contributed to the implementation of research projects, 37,3 % agreed, 5.9% neither agreed nor disagreed, 9, 8 % disagreed, and 2% strongly disagreed.

Research funders make it difficult to implement projects in a way that benefits the communities

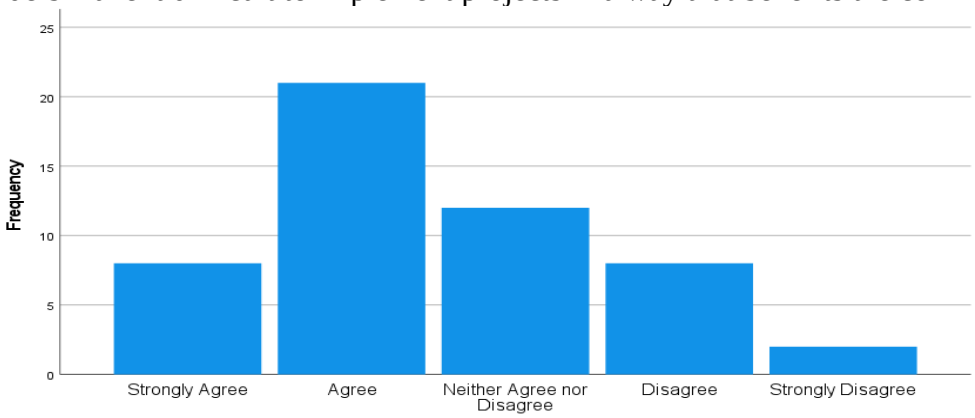

Figure 2 Research Funders Implementation Project in a Way that Benefits the Communities

The findings revealed that 15,7% of participants strongly agreed that research funders make it difficult to implement the projects to benefit the communities, 41,2% agreed, 23,5% neither agreed nor disagreed, 15,7% disagreed, and 3,9% strongly disagreed.

Community buy-in is essential before the implementation of a community-based research project

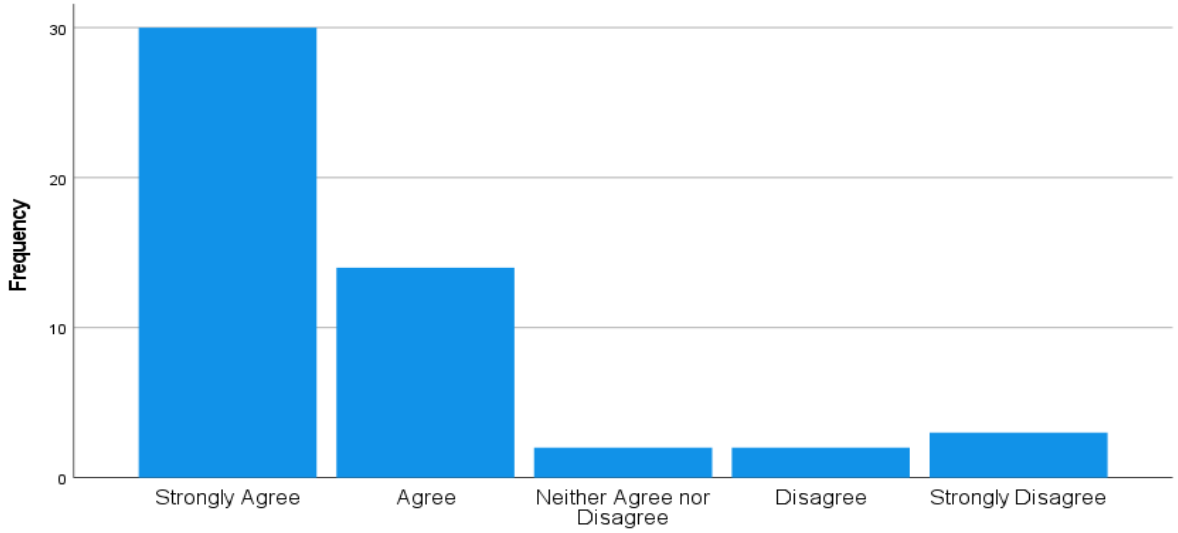

Figure 3 Community buy-in is Essential before the Implementation of a Community-Based Research Project

The results revealed that 58,8% of participants strongly agreed that community buy-in is essential before the implementation of community-based research projects, 27,5% agreed, 39% neither agreed nor disagreed, and 3,9% disagreed. Finally, 5,9% strongly disagreed.

Community participation is the answer to community development and can improve community-based research outcomes.

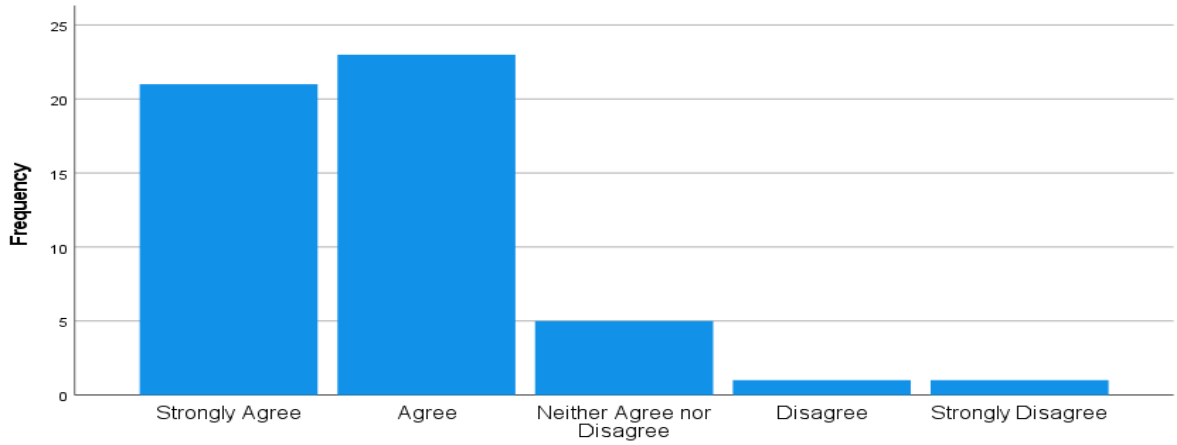

Figure 4 Answer to Community Development and Improve Community-based Research Outcomes

The findings revealed that 41,2% of participants strongly agreed that community participation is an answer to community development and can improve community-based research outcomes, 45,1% agreed, 9,8% neither agreed nor disagreed, and 2% disagreed. Finally, 2% also strongly disagreed" (Ngcobo, 2023:100-129).

Findings from in-depth interviews with researchers in the research organisation

The following themes emerged.

Community sensitisation.

The result revealed that community sensitisation is a critical step when implementing community-based research projects.

> *"You have to work with the community from the start and understand what is needed from the community. This can seem like an obvious thing, but it does not happen."* (Ph.D. Level, +10 years of experience)
>
> *"Community sensitisation is the most important part of community-based research planning. It is the process that assists to gain smooth community entry."* (Prof Level, +10 years of experience)

Unrealistic expectations from the funders.

The research organisation that receives research grants to undertake community-based research projects revealed that they sometimes face challenges when funders develop project concepts without understanding the community's needs where the projects are implemented.

> *"The challenges related to the concept, sometimes we find ourselves with the research agenda that does not address the agenda for the community in which the projects are implemented. However, we must proceed with the implementation of these studies in the community."* (Ph.D. Level, + 5 years of experience)
>
> *"The issue of concepts is huge. When funders develop the concepts without first being exposed to what is happening on the ground. Funders, for example, will develop the project concept by looking at the community, which has completely different needs than the one where the proposed project is supposed to be implemented."* (Masters Level, +10 years of experience)

Lack of adequate funding for community-based research projects.

Collaboration is one of the guiding principles of community-based research, which emphasises learning and empowerment for all stakeholders (K. Strand et al., 2003). However, findings highlighted funding issues that lead to community exclusion when implementing community-based research projects.

> *"In 22 years working in community development, I have learned the importance of developing and designing the implementation processes that begin with the consultation of communities because they are the ones who understand what problems they are facing and affected. The community provides lots of information; that is useful to the project. However, unfortunately, that step is usually skipped for many reasons, including lack of resources because there is less or no donor funding for community-based research."* (Ph.D level, +10 years of experience)
>
> *"We just go to the community, collect data and go, which is very sad, even if we have something in mind, but due to lack of resources, we end up living after collecting the data." (Ph.D. Level, +10 years of experience)."* (Ngcobo, 2023:129)

Findings from focus group discussions conducted with the community members based in KwaZulu-Natal.

The following themes emerged.

Political and cultural interference in community-based research implementation

The findings indicate that political and cultural interference in the implementation of community-based research projects has been causing a significant problem in the community. According to the results, politicians and cultural leaders sometimes use community-based research for political gain. As a result, the community members allowed to participate are those who support their political party and cultural leaders.

> *"The researchers come with their research, but most of the time, it becomes political. So, if the council is leading in that time, for example, if the council belongs to the ANC, people that*

will be recruited to participate in the research will only be those who belong to that political party." (FGD)

"There is also a big problem with the research; people who get employed to work with the researchers depend on which political party or cultural leader you are involved with. Therefore, research will only benefit the communities, depending on whom you know in the community or which political party or cultural leader you are involved with." (FGD)

In and out of researchers result in a lack of interest in participating in community-based research projects.

The results suggest that community members have lost faith in community-based research. They revealed that having researchers in the community gives them hope that their problems will be resolved. However, when researchers collect data and then leave the community without articulating their findings, the community loses hope that their problems will never be solved.

The community members indicated that they believe the researchers are exploiting them to obtain data for their benefit and not for the community's.

"Most researchers will come here and waste our time; they give us false hope. We take our time participating in the research, but after that, nothing happens; they do not even take time to tell us about the result of the research. Once the project is concluded, they will be gone. The next team of researchers will come again, and we will be expected to participate again, and the same thing will happen. It is a never-ending situation with the researcher in this community." (FGD)

"There is so much community-based research that has been conducted in our area, but I would be lying if I said there is something we benefited from participating, except providing information to the researchers." (FGD)

"Not even one of the researchers felt it necessary to tell us the research findings. They come and collect data; after that, they leave without a word, and will see them coming again with another research and do the same thing." (FGD)

Community consultation before community-based research implementation.

The findings suggest that the community should be consulted before implementing community-based projects. Participants indicated that informing them first can help them understand the projects. It will also inform the community before political and cultural leaders use them as their initiatives.

"We need to know what is happening in our community and why. Sometimes when we see people going up and down in the community, we do not even know if these are political party canvassing; sometimes, we get reluctant to get involved. (FGD)" (Ngcobo, 2023:130).

Findings from in-depth interviews with the Government Stakeholders

The following themes emerged.

Community-based research projects are used to identify the community's needs.

Based on the findings, government departments provide funding for community-based research projects to understand the community's needs better.

"We hear about community needs, and these projects give them hope that somebody is there to listen to them, and their needs will be addressed." (Government department senior staff member)

"We go and have meetings with different communities, and the community will sit down and identify the need. The community will map out the important things they wish us to focus on. The department team will then sit down and plan; once the planning is concluded and fits with the department-integrated plan, we can make the provision for it." (Government department senior staff member)

Importance of community-based research projects

Participants argued that a community-based research project is a tool used by Government departments to understand and hear directly from the communities what their challenges are to deliver the required services rather than to speculate on the problems. Participants expressed the following sentiments in this regard:

> *"What helps us when we conduct the community-based research is that we hear from the people who are in that particular community so that we know what their challenges are and what they need so that we can be able to put or deliver the services that are in requirement in that particular moment."* (Government department senior staff member)

Community to have ownership of the process of community-based research implementation.

The results suggest that community-based research empowers community members to own the interventions in their target area. This is because they gained the opportunity to provide information about community challenges by participating in a community-based research project.

> *"What is also important is that the community need to feel or have the ownership of the project interventions implemented in the communities that is crucial."* (Government department senior staff member)
>
> *"If the community members become part of the process, they develop a sense of ownership and the sense of belonging and also be empowered by their involvement in these kinds of projects."* (Government department senior staff member)

The lack of resources impedes the implementation of community-based research findings.

The findings suggest that Government departments are experiencing difficulties in terms of funding or resource availability to implement what is recommended by the researchers after the conclusion of the community-based research findings.

> *"When we are ready to implement, we will discover that the project is no longer a priority because they have moved on to other projects that they believe should be prioritised. So those are some of the challenges and conflicts that exist within the Department."* (Government department senior staff member)
>
> *"The main issue is a scarcity of resources. Therefore, we look at what is available, prioritise projects that are critical within resource constraints, and end up phasing out developmental projects based on the organisation's available capacity." (Government department senior staff member)"* (Ngcobo, 2023:159).

4.2 Discussion

Community-based research is used to identify the community's needs.

Findings revealed that government departments fund or provide grants for community-based research projects. In doing this, they collaborate with research institutions to comprehend community needs and provide intervention programmes that will improve the living conditions of the communities; as indicated by the government senior official interviewed, *"Community-based research projects are identified based on the needs of the communities. Then, when we craft or develop interventions for the programmes, we will have the programmes that will be appropriate and more responsive to what the community needs."* (Government department senior staff member).

The findings are consistence with that CBR is a type of participatory research that addresses community needs by combining the practical knowledge and experiences of community-based agencies with knowledge from academic and research organisations (P. R. Elson et al., 2018). These findings, however, raise an important question. Why are there such disparities between urban and

rural areas if government departments have collaborated with these institutions to understand better and improve the communities' living conditions?

Community consultation before community-based research implementation.

The participants revealed that researchers must consult them before they enter their community. They suggested that this process will assist them in understanding what projects are about and avoid confusion about whether they are attached to any political or cultural initiatives. The findings were supported by the following theme that also emerged, indicating that Community buy-in is essential before the implementation of a community-based research project.

The results from the research organisation revealed that 58,8% of participants strongly agreed that community buy-in is essential before the implementation of community-based research projects, and 27,5% agreed. Furthermore, the participants indicated that community participation plays a crucial role when research projects are implemented, where 45,1% of participants who are researchers strongly agreed, and 37,3% agreed. This was supported by Nyirenda et al. (2018) when articulating that community engagement or consultation in research design is widely recognised as a crucial approach that can establish a platform for dialogue and a new perspective for research projects.

Community participation is the answer to community development and can improve community-based research outcomes.

The result from the research organisation suggested that community participation is the answer to community development and can improve community-based research outcomes. The finding revealed that 41,2% of participants strongly agreed, and 45,1% agreed. This was asserted by the findings from the government department when they highlighted that community-based research is a powerful tool that assists communities in identifying their needs and gives the community members a sense of ownership for the interventions implemented in the community where they reside. These findings are consistence with the participatory action research approach, which is one of the research approaches that are truly responsive and committed to finding solutions to real-world issues (Canlas & Karpudewan, 2020), including bridging the gap between urban and rural communities because the communities will have identified their challenges that can bridge the urban-rural disparity and improve the living conditions of all community members.

Unrealistic expectation from the funders.

The participants revealed that the funders sometimes develop a research agenda that does not address the community needs where the community-based research projects are implemented. This was also supported by most researchers. 41,2 per cent agreed that research funders make it difficult to implement the project in a way that benefits the communities, and 15,7% strongly agreed. The findings were inconsistence with that community-based research to be meaningful and beneficial, should be "characterised by the active participation of researchers and participants in the co-construction of knowledge; the promotion of self-and critical awareness that leads to individual, collective, and or social change; and an emphasis on a co-learning process in which researchers and participants plan, implement, and establish a process for disseminating information" (McIntyre, 2007:5). As a result, the finding reveals the important factors that might contribute to urban-rural divide in KwaZulu-Natal.

In and out of researchers results in a lack of interest in participating in community-based research projects.

According to the respondents, researchers frequently engage the community to conduct community-based research. However, this has never benefitted the community. As a result, community members are reluctant to participate because researchers leave nothing behind that will benefit or address the community's problems. *"The researchers come and go in our community, but to tell you the truth, I*

lost trust in the research because when we see the researchers in our community, there is hope and expectation for us as the communities, but most of the time, they disappear after collecting the data."(FGD) and *"There are so many community-based research that has been conducted in our area, but I will be lying if I say there is something that we benefited from them, except providing information to the researchers* (FGD)" (Ngcobo, 2023:130). This was supported by the researcher's claim when they indicated that they did not have enough funding to implement community-based research projects. It also verifies what the government department leadership claimed; when they admitted to difficulties implementing interventions derived from the community-based research. According to Kirk and Shutte (2004), government departments that engage in dialogue can result in an agreement between the stakeholders even if they do not share the same rationale for agreement to the agreed-upon path or intervention.

The lack of resources impedes the implementation of community-based research findings.

The findings indicate that government departments frequently face challenges when it comes to implementing interventions after community-based research has been completed, either due to a lack of funding or because those projects are no longer a priority. They argued that because there are so many urgent requests, including disasters, in the communities, they sometimes do nothing to deal with the issues or challenges identified when community-based research projects are implemented. These findings provide a clear indication of some of the factors that contribute to urban-rural disparities. According to Dlamini et al. (2020), poor planning in the South African government sector has resulted in poor service delivery in different departments, leading to a decline in the quality of service allocation and the poor implementation of development projects.

Political and cultural interference in community-based research implementation

The findings indicate that the other challenge contributing to the urban-rural divide is political and cultural interference when implementing community-based research projects. As a result, these leaders will want to choose who should participate in the research project resulting in a research outcome that does not deal with the problems of all the community members but only a few. These findings therefore are inconsistence with that CBR approach that prioritises partnership, inclusion, and social justice agendas (Flicker et al., 2008). In addition, the exclusion caused by community leaders when community-based research projects are implemented may fail structural development policies designed to integrate rural and urban aspects because they were based on inaccurate assumptions about the relationship between the two, as some community members were being excluded based on their affiliations with community leaders.

4.3 Recommendations

Create opportunities for skill development through community partnership.

In accordance with the principles of CACT Government departments should collaborate with research organisations and communities. This collaborative approach must be initiated at the inception of community-based research projects, emphasizing the critical role of community-based research in addressing the specific needs of the community, particularly in rural areas. Therefore, it is crucial to use community-based research to address the community's needs, including understanding the skills available in the community, especially in rural areas. Researchers, in turn, play a pivotal role in guiding communities towards harnessing the potential of partnerships to confront intricate challenges, drive societal change, and cultivate a diverse range of skills. These newly acquired skills empower communities to actively participate, acquire knowledge, and become self-reliant once the research initiatives have concluded. This approach can prevent rural communities from falling behind those

living in urban areas. According to OCDE (2014), the communities in rural areas are often cut off from training and skill development opportunities needed to stay competitive. Besides, demographic disparities are growing as urban areas continue attracting skilled individuals at the expense of many unskilled people living in rural areas.

Creating partnerships between rural and urban settings

Creating partnerships between rural and urban settings is crucial. Research organizations should embrace Participatory Action Research (PAR), emphasizing collaboration to empower local communities and devise innovative solutions to bridge urban-rural disparities. Additionally, researchers need to guide government departments in tailoring funding approaches for community-based research, acknowledging the unique challenges and needs of each community. Establishing partnerships and coalitions between government entities, research organizations, and communities fosters collective efforts, enabling communities to identify their challenges and work on suitable resolutions.

Inclusive policies that foster rural development

Inclusive policies are fundamental for rural development. Government initiatives should focus on developing and implementing policies that foster inclusive rural transformation, ensuring equal opportunities for all community members to exercise their social, political, and economic rights. This inclusive approach allows community members to acquire skills and leverage available opportunities, facilitating significant advancements that bridge the urban-rural divide.

Flexible project implementation

Flexibility and adaptability are key when implementing community-based research projects, given the ever-changing nature of urban and rural challenges. Efforts must be underpinned by an emphasis on inclusivity and the equitable distribution of benefits. This ensures that marginalized communities are not left behind, promoting a balanced and sustainable development approach that benefits everyone involved.

5. CONCLUSION

The study was conducted with one research organisation in KwaZulu-Natal. These findings are therefore not generalizable to all the research organisations in KwaZulu-Natal. However, the research organisation does have significant experience in the subject area in discussion for this paper and therefore the results do contribute to knowledge generation on evidence-based strategies for conducting successful and sustainable community-based research in South Africa.

This paper concludes by emphasising the significance of coalition efforts in community-based research that offers a promising path towards developing functional urban and rural communities in KwaZulu-Natal. Community-based research is an indispensable tool in the pursuit of liveable communities. It empowers residents to take an active role in shaping their communities, fosters equity and inclusion, supports sustainability, and strengthens social cohesion. Achieving a liveable community is a collaborative effort that requires the active engagement of community members, researchers, and policymakers. By recognising the pivotal role of CBR in this process, we can work towards creating communities that are not only sustainable but also vibrant, inclusive, and conducive to a high quality of life for all residents.

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WATER AWARENESS IN THE *IRUNG-IRUNG* TRADITION AS IMPLEMENTATION OF WATER AND SANITATION MANAGEMENT FOR THE COMMUNITY OF CIHIDEUNG VILLAGE, WEST BANDUNG REGENCY

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ABSTRACT

The local wisdom that exists within a community plays a crucial role in influencing the thinking and conduct of the community. One local wisdom that contains a hydrological educational message that impacts community awareness in maintaining water hygiene and proper sanitation is the *Irung-Irung* Tradition by the people of Cihideung Village, West Bandung Regency. The objective of this study is to comprehensively examine and assess the components of water awareness within the *Irung-Irung* Tradition practiced by the people of Cihideung Village in the West Bandung Regency. This study involves a descriptive qualitative research design, including data collection methods such as interviews, observation, and literature review. The employed data analysis technique encompasses data reduction, data display, and conclusion. The findings of the study indicate that the element of water awareness in the *Irung-Irung* Tradition contained a philosophical meaning in the form of an expression of gratitude to God for a spring that never subsides, respect for the spirits of the ancestors, and strengthening the bonds of brotherhood among the residents of Cihideung Village. The *Irung-Irung* Tradition is an effort to enhance awareness and concern for the people of Cihideung Village about the urgency of water and sanitation management manifested in community service activities and cleaning springs and waterways. Therefore, the values in the *Irung-Irung* tradition are local wisdom that participates in realizing the sixth sustainable Development Goals (SDGs) related to water accessibility and proper sanitation.

Keywords: *Irung-Irung* Tradition; Local wisdom; Water awareness

1. INTRODUCTION

Water conservation is crucial because maintaining water sources has had a massive effect since the beginning of human civilization. Clean water is a global mission that must be realized together. Therefore, efforts are needed on a micro and macro scale to build collective awareness to maintain water quality by committing to and contributing to prevention. In addition, concrete actions and consideration of all hydrological consequences in every decision are important in order to make water, which is a source of life, more accessible across the board.

Regarding the issue of water scarcity, reported on the UN website, two billion people still live without clean water services that are safe for consumption, even 1.2 billion people still have not met their water services that are safe for consumption, even 1.2 billion people still have not met their water needs at the primary level (United Nations, 2020). This statement serves as a stark reminder that we cannot take the availability of clean water for granted.

One of the Sustainable Development Goals (SDGs)—specifically, the sixth point—includes water hygiene and sanitation. The issue of water hygiene and sanitation has interconnections with other goals because water hygiene and sanitation are two of the initial foundations for enhancing the

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standard of human existence. The provision of clean water and sanitation is subject to intricate constraints that rely on the decisions made by various players across all levels of government, the commercial sector, non-governmental organizations, and the general public (Tortajada, 2020). Therefore, addressing the issue of water hygiene and sanitation requires involvement from all societal levels. Indonesia, as a country with 278,696.2 million people in the middle of 2023 (BPS, 2023), needs to take the issue of water hygiene seriously. The water quality index in Indonesia stands at 52.82 in 2021, suggesting that conditions frequently deviate from the anticipated level (marginal) and that over 40 million individuals continue to lack access to sufficient water sources (Statista, 2023).

A study on the correlation between population and water quality in Indonesia found that for every As the population increases, the water quality index will decrease (Kustanto, 2020). Suppose the community in Indonesia can be empowered to become agents of change, leading to a revolution in concern for water quality because a high population could become a boomerang or an opportunity. In that case, water conservation as an effort to maintain water quality can be realized. Each individual can participate in solving clean water and proper sanitation problems on a micro-scale by supporting, strengthening, and joining the local community that implements water and sanitation management. As a multicultural country, Indonesia presents a unique opportunity to empower society by fostering a deeply rooted culture within the community. Values that have crystallized in society for a long time and translated into a tradition can be used to address global problems because the destination point of the life of local wisdom is not just to perpetuate cultural elements; more than that, local wisdom can go hand in hand with a universal mission to create a community that is visionary and based on sustainability. Traditions encompass tangible artifacts and intangible concepts that originate from the past, persist in the present, and remain uneradicated, harmed, discarded, or neglected (Sztompka, 2004). Knowledge and values incorporated into local worldviews support behavior that promotes respect between people and protects the environment (Sandoval-Rivera, 2020).

Local wisdom refers to a holistic combination of information, beliefs, understanding, insights, and established ethical practices that govern the behavior of individuals within an ecological community (Sumarmi, 2015). The *Irung-Irung* Tradition is a form of gratitude for the people of Cihideung Village, West Bandung Regency, for the source of the *Irung-Irung* spring, which has never receded. The *Irung-Irung* tradition is a local wisdom in Indonesia that embodies philosophical significance pertaining to the value of water conservation. This wisdom is manifested via practical initiatives aimed at empowering the community to uphold clean water and sanitation standards within the surroundings of Cihideung Village. The *Irung-Irung* tradition's inaugural activity serves as a tangible expression of the community's commitment to water cleanliness and sanitation. Before the peak event of the *Irung-Irung* tradition takes place, namely carrying out a parade with various kinds of arts, rituals, and prayers at the *Irung-Irung* spring, the residents of Cihideung Village clean the environment around the spring and all the waterways in the village. The *Irung-Irung* Tradition, carried out by the people of Cihideung Village, translates philosophical meaning into concrete and impactful actions. Carry out *Irung-Irung* Tradition, which contains a strong message about the importance of clean water and the surrounding environment, illuminates the awareness of the people of Cihideung Village in realizing water and sanitation management. The people of Cihideung Village routinely carry out voluntary work to clean water sources and water canals to avoid disease. Water and local wisdom are valuable assets that must be preserved (Ferry, 2019). Hence, the *Irung-Irung* Tradition, as a local wisdom that is so vocal in passing down ecological values, will impact the formation of a long-lived collective consciousness.

Cihideung Village is located in Parongpong District, West Bandung Regency, with most people making a living as ornamental plant sellers. Cihideung Village has an annual tradition, *Irung-Irung* Tradition, held every August. *Irung-Irung* is the name of a spring located not far from Cihideung Village. The *Irung-Irung* spring's source is in the Lembang Park Zoo tourism area, which opened at the end of 2019. However, the touch of the times does not affect the implementation of the *Irung-*

Irung Tradition, carried out hundreds of years ago. *Irung-Irung* Tradition is a tradition of the people of Cihideung Village in which the people of Cihideung Village flock to the *Irung-Irung* spring to pray and slaughter a goat as a form of gratitude to God, as well as respect the traditions of their ancestors. This tradition also contains cultural elements, such as tari ketuk tilu, kuda lumping, and the jampana parade, which becomes entertainment after performing the ritual at *Irung-Irung* springs. More than that, the unique and meaningful thing that makes this tradition one of the local wisdoms that moves in harmony with the global mission is a series of traditions starting with the holding of voluntary work to clean the springs and all the waterways in Cihideung Village one day before holding rituals and entertainment at the *Irung-Irung* springs. In the past, community service activities cleaning springs and all channels were carried out on the ritual day. However, over time, community service activities were carried out one day before the ritual and entertainment were held so that the community service could run optimally. The devotional work that is done before the performance of the ritual is a critical moment that enriches the *Irung-Irung* Tradition because this tradition is not only oriented towards the conservation of philosophical values passed down from their ancestors but also embraces the entire community of Cihideung Village to translate these philosophical values into collective action that has an impact on the welfare of the people of Cihideung Village.

This research explored several questions: (1) What does The *Irung-Irung* Tradition mean? (2) What is the sequence of the *Irung-Irung* tradition? (3) Why does the *Irung-Irung* Tradition contain elements of water awareness in water and sanitation management? This research sought to understand the Irung-Irun Tradition and analyze the elements of water awareness in the *Irung-Irung* Tradition people of Cihideung Village, West Bandung Regency. This research is expected to help the community capture messages regarding concern for water and the surrounding environment from the *Irung-Irung* Tradition. Communities can also have a new perspective on interpreting local wisdom, one of which is by believing that local wisdom has a strategic role in solving global problems because organic awareness of local communities can be the first step to creating exponential progress.

2. LITERATURE STUDY

Culture and society are two things that cannot be separated. Anthropology defines culture as the comprehensive framework of ideas, acts, and human creations that exist within a society and are acquired via learning, with the main contents of culture including language, technology systems, livelihood systems, social organizations, knowledge systems, information systems, religion, and art (Koentjaraningrat, 1985). A culture that develops in society has its own style, and if this culture is interpreted more deeply, then culture can serve as a means to address societal issues. Not infrequently, the culture that lives amid society is transformed into a mindset or behavior that contains wisdom values that significantly impact the lives of local people down to the next generation because these values are continuously revived and maintained in the community amid endless turbulence. Local wisdom refers to ideas or activities that encompass methods of engaging with fellow individuals, human beings, the natural world, the surroundings, and their systems of belief (Jumriani et al., 2021). Local wisdom is a local community belief that correlates with nature (Uspayanti et al., 2021). The existence of local wisdom in culture can provide new options in society to protect the environment. Local wisdom that has existed for a long time has internalized the values contained in local wisdom in people's lives, intentional and otherwise. Protecting the environment has become a common goal that needs to be fought for, and activities that contain cultural elements can be steps taken by local communities to realize this goal (Lestari et al., 2021). Cultural activities seen by the community as a form of respect for ancestors with sacred nuances give these cultural activities space in the memory of the community because these cultural activities have been carried out consistently since ancient times.

Epistemologically, tradition comes from the Latin word 'tradition', which means habits similar to culture or customs. In the anthropology dictionary, the definition of tradition is the same as custom, namely habits that have a religious magical nature from the life of a native population in which there are cultural values, norms, laws, and rules that are interconnected and then become a system or rule that is strong and consists of all cultural system conceptions of a culture to regulate human actions and actions in social life (Suyono, 1999). According to the sociology dictionary, a tradition is a notion that has been passed down and is sustained from generation to generation (Islamah, 2017). Soerjono Soekanto defines tradition as a continuous activity that a group of people or society engages in (Rofiq, 2019). Tradition refers to the shared presence of physical objects and concepts that have their origins in the past and continue to exist in an undamaged state. Tradition is a historical inheritance, yet recurring traditions are not accidental or intentional (Sztompka, 2004).

In general, people's traditions that are aware of water management and water sanitation, such as the Huluwotan celebration, the Parafu tradition, and several traditions related to water maintenance, are because they are aware that protecting water is very important. This is in accordance with Antonio Gramsci's theory regarding consciousness, namely that consciousness is a condition where we understand a situation or character condition in the society in which we live (Fitriyah, 2017). Some people interpret traditions that are believed to be saviors in distress. Because if local residents damage or pollute the water, it will have an impact on the community itself, whether it has an impact on the environment, health, or the traditions they believe in. Another reason is that the local community practices water management and sanitation as a way to express gratitude to God Almighty for the gift of water. This tradition of thanksgiving, which involves cleaning the water and water springs, enables the community to protect and maintain the water resources. Therefore, local communities must have the awareness to preserve and manage clean water so that springs and water channels are kept clean (Mulyanti, 2022; Ningrum, 2021; Saraila, 2016).

Local wisdom contained in a tradition strongly affects society because people can sense the momentum and participate actively in its implementation; for example, in *Irung-Irung*, Tradition is oriented towards efforts to maintain the quality of waterways, which will impact the quality of sanitation. Communities meet water needs by utilizing and managing water resources in their area according to local wisdom practiced for generations, and the form or type of local wisdom varies according to community groups and regions. Still, as social capital, local wisdom has the same universal value: cooperation and mutual help to get water and maintain the sustainability of its resources (Hidayati, 2016). The urgency of protecting water quality is reflected in the culture that lives in the community. Local wisdom comprises a range of elements, including knowledge, values, ethics, and morals; norms manifest as recommendations, prohibitions, and sanctions; and expressions serve as guiding principles for community attitudes and conduct regarding the preservation, protection, and conservation of springs (Dwiatmojo et al., 2018; Siswadi et al., 2012). Therefore, to maintain water quality, a collective effort is needed from the community, and the existence of communities in Indonesia is often inseparable from the community's religious system or elements passed down through norms, sayings, traditional ceremonies, or traditions, as well as legends and local wisdom. They are passed on to the next generation through socialization and enculturation processes in informal education (Liesnoor Setyowati et al., 2017). Local wisdom can serve as a catalyst, mentor, and community point of reference in the process of designing, executing, and assessing water resources and their applications (Hanif et al., 2021). The impact resulting from the organic movement that grows in the community to protect water resources is a force that cannot be underestimated because the values contained in local wisdom are still relevant to today's conditions.

3. METHODS

This study adopts a descriptive-qualitative approach to comprehensively examine the phenomena of perception, motivation, action, and other related factors. The research aims to gain a deep understanding of these aspects by utilizing descriptive language and various scientific methods within a specific natural context (Moleong, 2007). The aim of qualitative descriptive research is to offer a thorough overview, using easily understandable language, of the particular occurrences experienced by people or groups. This type of research often draws upon naturalistic inquiry, which seeks to study a phenomenon in its natural state to the greatest extent possible within the research context (Vickie A. L. & Clinton E. L., 2012).

The researchers employed triangulation strategies for data collection, wherein many data-collecting methods were utilized to get information from a singular source (Sugiyono, 2013). The data utilized in this study has been derived from a combination of observational methods, interviews, and an extensive review of relevant literature. A series of observations were conducted in order to gather data pertaining to the environmental conditions present in Cihideung Village. The informants for the interview were purposefully picked based on their alignment with the researcher's specific criteria. These criteria focused on identifying individuals who played a direct role in the planning and execution of the *Irung-Irung* tradition. The study was conducted in Kancah Village and Cihideung Village, located in the West Bandung Regency, during the month of January in the year 2023. The initial task undertaken involved the observation of the environmental conditions within Cihideung Village. The subsequent task involves conducting an interview with the informant. The interview encompassed a range of inquiries pertaining to the *Irung-Irung* tradition, including its significance, various customs such as community service initiatives and artistic performances, and hydrological implications, specifically addressing the village community's emphasis on clean water and sanitation, as well as their regular engagement in communal service endeavors.

The subject of discussion is Cihideung Village. The literature review technique involves incorporating information derived from prior studies. The employed methodology for comprehending the data is as follows: 1) The process of data reduction involves the selection of data obtained from interviews, observations, and secondary sources such as scientific articles that pertain to local wisdom with hydrological implications, as well as data concerning issues related to clean water accessibility. The purpose of including secondary data is to reinforce the primary data. 2) The presentation of data involves the rephrasing of information obtained from various sources, providing detailed explanations of previous research findings, and interpreting the data that has been collected. 3) Conclusions are derived from the analysis of data derived from field notes, observations, and a review of relevant literature. It is important to note that conclusions are drawn only after the completion of data analysis activities.

4. RESULTS AND DISCUSSION

The philosophical meaning of the *Irung-Irung* Tradition is a manifestation of gratitude to God for the creation of *Irung-Irung* springs, which has never subsided since hundreds of years ago, as well as a hydrological educational message related to the importance of maintaining the quality of clean water which is implemented in community service activities as a series of opening *Irung-Irung* Tradition. This tradition strengthens the bonds of brotherhood among the residents of Cihideung Village because all the people of Cihideung Village contribute materially and non-materially to the continuation of this tradition. Young people who are members of youth organizations are actively involved in making the whole tradition a success. The most crucial orientation in involving youth organizations in planning and implementing the *Irung-Irung* Tradition is to raise awareness, organize the younger generation's involvement in learning democracy in society, and preserve local wisdom (Nanggala & Malihah, 2020). The involvement of young people in this tradition is precious because the

participation of young people is a form of cultural inheritance, so the philosophical meaning and series of the *Irung-Irung* Tradition, which is thick with ecological values in increasing concern for the environment, especially water hygiene, can be perpetuated and not allowed to become extinct over time. The participation of all community members in Cihideung Village raises concerns about cleanliness, which can have a domino effect on improving the quality of public health in the long run contained implicitly and explicitly in the *Irung-Irung* Tradition. More than that, this tradition can also act as a driving force for habits to carry out water and sanitation management, which, so far, the village community has manifested in implementing routine community service outside the *Irung-Irung* Tradition.

Community involvement and concern are significant strengths because they act as a catalyst in solving problems, especially problems related to water quality, which impact the sanitation of the people of Cihideung Village. Community concern that grows from a culture that is old enough to make it an *Irung-Irung* Tradition as a means of communication both verbally through messages conveyed by traditional participants directly to local and non-local communities or through a series of traditional processions that have succeeded in providing an overview of community action in maintaining water quality which is so apparent and makes an impression because concrete action is one of the effective ways of passing down local wisdom values to future generations. According to the presentation of the source, if the *Irung-Irung* Tradition had never materialized, the start of the *Irung-Irung* spring could have been abandoned so that it would be filled with trash and grass. This tradition is growing awareness among the people of the importance of maintaining clean water quality because *Irung-Irung* springs are a source of life for the people of Cihideung Village. *Irung-Irung* Tradition has been inaugurated by the Department of Tourism and Culture of West Bandung Regency. While carrying out the *Irung-Irung* Tradition, government agencies also participated in this tradition. The Cihideung Festival, an event introducing Cihideung Village art activities, was once held with the *Irung-Irung* tradition. Cihideung Festival, which is carried out according to *Irung-Irung* Tradition, the last time it was held was in 2017, with the event's budget coming from the government. The Cihideung Festival has events for the creation of performing arts, exhibitions of ornamental plants, as well as cars and motorbikes decorated with flowers. Another term for the *Irung-Irung* Tradition is Ngalokat Cai, which was born from holding the Cihideung Festival. Ngalokat Cai comes from the Sundanese language, which means guarding the water. This term resonates with the philosophical meaning of preserving the *Irung-Irung* Tradition because this tradition is an effort to protect water through local wisdom and becomes a form of contribution that is unique and strategic in solving global problems.

Presidential Regulation (Peraturan Presiden) Number 111 of 2022 concerning the Implementation of the Achievement of Sustainable Development Goals states that Indonesia is a member of the United Nations, which actively sets Sustainable Development Goals (SDGs) goals. In order to achieve the accessibility targets for clean water and proper sanitation, Indonesia, as a country with diverse ethnicities, cultures, and customs, can utilize local wisdom as a means of support. This aligns with target 6.b of the SDGs, which aims to enhance local community participation in improving water and sanitation management. Local wisdom has a vital role in solving problems, especially the management of water resources, so that it is only natural for the community to continue to preserve it (Ferry, 2019). The meaning contained in local wisdom becomes part of people's lives, so a society grows with a culture rooted for a long time. Indigenous people have long stories about their land, which has provided sustenance in straightforward and intimate ways (Abas et al., 2022). Modern society may view local wisdom through the lens of cynicism and conclude that local wisdom is only limited to the ancient culture. However, people can perceive local wisdom as philosophical and likely to be translated into a mindset and actual realization. In that case, the existence of local wisdom in society can be interpreted through perceptions that are not shallow. Internalizing the ecological values embedded in local wisdom helps foster human consciousness in the management of the natural environment, hence cultivating positive ecological attitudes (Niman, 2019). Therefore, people who

participate in a tradition that contains ecological values can become a catalyst in efforts to pass on these positive values to the next generation. Traditions carried out are a momentum that leaves an impression in the community so that the messages contained in these traditions are easier to feel, adapt, and translate in collective action.

Local wisdom has two leading roles: meeting water needs for life and community life and maintaining a harmonious relationship between the community and the surrounding environment (Hidayati, 2016). A form of caring for water in the *Irung-Irung* Tradition:

First, the philosophical meaning of the *Irung-Irung* Tradition is a form of expression of gratitude for the source of water, which never recedes, even in the dry season. The gratitude to the Creator for the availability of water felt by the people of Cihideung Village proves that the people of Cihideung Village associate their lives with a vertical relationship or dogma that they have adhered to for a long time so that people's concern for water quality has a huge chance to continue to breathe in the community as an implication from the solid belief system of the local community. This tradition implies a vital message, namely the urgency always to protect water because water availability is a gift given by the Creator. Awareness is the first step of a change. Execution of the *Irung-Irung* Tradition is a way for the people of Cihideung Village to communicate the importance of keeping water clean to create a clean and healthy village environment.

Second, the initial sequence of the *Irung-Irung* Tradition is implementing community service to clean the springs and all the water canals in Cihideung Village. This activity is a form of realization of the philosophical meaning of the *Irung-Irung* Tradition. The awareness of the people of Cihideung Village about the importance of water hygiene is evident from the community's participation in managing water and sanitation, and more than that, this activity is also an effort by the Cihideung Village community to anticipate flood disasters. The people of Cihideung Village routinely carry out community service outside of the traditional time because for the people of Cihideung Village, community service cleaning springs and water canals is not a compulsion because it is part of the *Irung-Irung* Tradition but purely from a collective awareness of the importance of keeping water clean that has been built. Repetitive actions are expensive because consistency and community commitment must be continuously created and maintained to realize long-term prospects. The *Irung-Irung* Tradition, which is routinely carried out every year, can be used as a reminder for the people of Cihideung Village that maintaining water quality and sanitation is a task that will never be completed.

Third, the *Irung-Irung* Tradition, which has been carried out for hundreds of years, indicates that the ecological values in this tradition have been passed down from generation to generation so that this tradition has survived amidst the massive changing times. This tradition will always have a place in society because even though a cultural tradition may be seen as old-fashioned and irrelevant, the *Irung-Irung* Tradition is a micro-local community effort to realize a global mission. The issue of access to clean water and sanitation is still a severe dialogue at the national and international levels. Therefore, the younger generation involved in the *Irung-Irung* Tradition is an agent of change who will transfer hydrological education messages and actions to care for clean water to future generations.

In the neighborhood planning process, communities determine the future of the places where they live and work (Parker et al., 2019). Successfully implemented environmental planning can result in diverse forms of environmental planning that are reflected by interactions between institutionalized institutions, local conditions, policy repetition, and varying community-local scale dynamics (Parker et al., 2023). The *Irung-Irung* tradition practiced by the residents of Cihideung Village, which has implications for the emergence of public concern for clean water and sanitation, is a form of neighborhood planning carried out by local communities to ensure that their environment will continue to have access to clean water and adequate sanitation in the long run. Through the annual

Irung-Irung tradition, the villagers of Cihideung Village demonstrate to all participants that they live a sustainable lifestyle. The activity of cleaning water channels to maintain water quality and prevent disease, which is one of the primary activities in the *Irung-Irung* tradition and outside of the implementation of the tradition, is how the Cihideung Village community implements neighborhood planning that they formed organically because this tradition is a direct inheritance from their ancestors. Community neighborhood planning in Cihideung Village is obscure. Indirectly, the *Irung-Irung* tradition with its hydrological educational message contains the concept of neighborhood planning, which is reflected in the community's awareness of the negative consequences if traditional and nontraditional activities to clean water channels are not carried out. The future participation of the Cihideung Village community can create opportunities for more extensive neighborhood planning and transform it into a community with a sustainability mission. Neighborhood planning will create an intermediary level between city government, citizens, and other local actors, thereby increasing social capital and ultimately guiding the community (Aouad, 2022).

The *Irung-Irung* tradition is consistent with the mission of the SDGs, particularly in terms of clean water and appropriate sanitation. A sustainable community is one that ensures the well-being of present and future generations by safeguarding the integrity of the earth's life support systems while enabling present and future generations to engage in society it also implements policies that are inclusive and safe, meticulously designed, constructed, and regulated, and guarantee equitable access to superior services and a superior quality of life for all (Winston, 2022). The residents of Cihideung Village recognize the importance of environmental protection. The villagers of Cihideung Village are a community that prioritizes sustainability because their environmental mission is interwoven with their local culture, which is manifested in the community's local wisdom, namely the *Irung-Irung* tradition. Community development prioritizes the importance of attaining a harmonious equilibrium between environmental considerations and development goals, all the while improving local social connection and sustainable communities not only protecting and improving the environment but also cultivating a more compassionate local society (Abiddin et al., 2022).

The *Irung-Irung* Tradition practiced by the villagers of Cihideung Village is intended to preserve pure water and sanitation. According to UNICEF, the effects of unsafe Water, Sanitation, and Hygiene (WASH) on children can be catastrophic. According to UNICEF, more than 700 children under the age of 5 die every day from diarrheal diseases due to a lack of adequate WASH services, and in conflict zones, children are at risk of dying from contaminated water. There is a 20 times greater chance of dying from diarrhea than from the conflict itself. Through the *Irung-Irung* tradition, the people of Cihideung Village can disseminate messages regarding Water, Sanitation, and Hygiene (WASH). For effective community involvement in WASH (Water, Sanitation, and Hygiene), it is crucial to utilize leadership structures that are deeply rooted in the local culture, such as school instructors, religious leaders, and community leaders. (Tsekleves et al., 2021). Because the *Irung-Irung* tradition has always been a part of their culture, the people of Cihideung Village comprehend the significance of maintaining Water, Sanitation, and Hygiene (WASH). Local water users frequently have in-depth local knowledge regarding water resources, water requirements, and historical changes related to water use (Arimoro & Musa, 2020). Malolo et al. (2021) found that cluster-based and community-led WASH interventions can have positive social impacts, particularly for primary healthcare providers.

The *Irung-Irung* spring is so special for the villagers that they have their own traditions with the aim of continuing to maintain the sustainability and authenticity of the spring. The philosophy of the *Irung-Irung* tradition itself is to support the people living in Cihideung village. Known as the largest water source for the residents of Cihideung village, it is hoped that the *Irung-Irung* can and will continue to flow water quickly without any obstacles. Therefore, there must be good water security to maintain the quality or availability of sufficient water for village residents. Cihideung Village, which is located in West Bandung Regency, is a flower-producing tourist area for West Bandung

Regency. It is very natural for the residents of Cihideung village to do business in the floriculture sector for their survival. Floriculture is one of the agricultural sub-sectors that discusses the cultivation of flowers and ornamental plants (Ayesha, 2016). Floriculture is closely related to the people living in Cihideung Village because most of the people work as flower farmers. If the *Irung-Irung* as their water source is damaged or dries up, it is certain that all Cihideung flower farmers will have difficulty irrigating their flower fields. In the worst-case scenario, they will not be able to depend on their source of livelihood as farmers and flower sellers. Therefore, remembering how important the existence of *Irung-Irung* is, traditionally and from generation to generation, the residents of Cihideung Village routinely hold a ritual for cleaning *Irung-Irung* or Ngalokat Cai. The *Irung-Irung* Tradition is still maintained by the residents of Cihideung village with the aim of guarding, caring for, protecting, and respecting water sources for their livelihood. In this ritual, cleaning of gutters and water channels is also carried out, both around *Irung-Irung* and along the roads in Cihideung Village. It is hoped that by continuing to carry out the *Irung-Irung* Tradition, the availability of water in Cihideung village will be sufficient for daily life and the future.

According to (Setyobudi et al., 2018) the revitalization of the tradition of preserving and caring for the *Irung-Irung* spring is a form of a local community effort to maintain water security. The aim of maintaining water security is to maximize the benefits of water for humans and the ecosystem (Mishra et al., 2021). Another goal is to reduce the destructive risk caused by too much or too little water. These risks include for example too much water, too little water, or poor water quality. A large amount of water alone is not enough to meet the living needs of the residents of Cihideung village, clean water is also very necessary for their survival. If a region or even a country does not have a good water management system, water will eventually become scarce. This is a nightmare for everyone, especially the residents of Cihideung village whose lives depend heavily on water. In fact, the impacts resulting from poor water security in an area can be very fatal, ranging from the death of the agricultural economic sector to the extinction of humanity. Water security is closely related to food security, therefore when water insecurity begins to emerge, it can cause drought and famine. Moreover, water insecurity can cause low levels of food production, poverty, lack of sustainability, and other water-related disasters.

Based on WHO data, Indonesia is one of the countries with a 5% increase in basic sanitation within five years (2015-2020) (WHO & UNICEF, 2021). This figure is indeed quite good, but Indonesia still has to improve the quality of public sanitation continuously. Based on data from the Central Statistics Agency regarding the percentage of households in the province that have access to sanitation, West Java Province is at 74.02% and is still quite far compared to other provinces, which have reached 90% (BPS, 2022). *Irung-Irung* Tradition, as one of the local wisdoms in West Java, can play a role in solving the problem of the availability of proper sanitation in West Java. Developing innovation by adopting local wisdom is an option as a source of community independence in sustainably managing water resources (Sallata, 2015). Based on the presentation of the head, with the existence of the *Irung-Irung* Tradition, the Cihideung Village environment is kept clean. Water sources are not filled with garbage, and water channels are maintained so that it will impact people's health. Activities to clean water sources in a series of *Irung-Irung* Tradition is also a form of anticipation for the people of Cihideung Village against floods. This proves that local wisdom can contain disaster preparedness values. Preparedness in the context of disaster is defined by the United Nations International Strategy for Disaster Reduction (UNISDR) as the knowledge and capacities developed by governments, professional response and recovery organizations, communities, and individuals to anticipate, respond to, and recover from effectively, the impacts of likely, imminent or current hazard events or conditions (UNISDR, 2009).

Local communities can have a set of habits and views and local wisdom that provides resilience and strength for growth to face and control geographical challenges, such as floods that hit the area where the community lives (Basri, 2021). Local wisdom that has an impact on local communities in

anticipating flood disasters has been proven in various places, for example, the Citarum River in Bandung, Kampung Melayu in Semarang, the Tolaki tribe in Southeast Sulawesi, and people in Japan (Bakti et al., 2017; Hos et al., 2021; Itsukushima et al., 2021; Kurniawati et al., 2019). Therefore, local wisdom that has lived for hundreds of years can be a strategic step in maintaining and strengthening the commitment of local communities to anticipate disasters, especially floods. Thus, the relevance of local wisdom that is quite old is no longer questioned today because local communities can maximize local wisdom in facing contemporary challenges and the dynamics of the times that make local communities transform into communities that have resilience in the modern era.

The participation of the Cihideung Village community in implementing water and sanitation management is influenced by traditional philosophical values. It is a form of concern for local communities involved in solving water and sanitation problems. Efforts to conserve water resources can be carried out community-based by making the community the main subject in water resources conservation activities (Kariada, 2021). Therefore, the role of the people of Cihideung Village, who hold traditional values to be transformed into action, needs to be appreciated. The Cihideung Village community has succeeded in holding on to a commitment to carry out a tradition that contributes to maintaining water quality, which impacts community sanitation. Currently, many efforts are being made to deal with various environmental problems, especially the availability of water, and the people of Cihideung Village, through *Irung-Irung* Tradition, convey the message that efforts to overcome a problem do not always require novelty, innovation, or up-to-date tools. However, the role of society glued together by a culture rooted for a long time can also contribute in a unique and authentic form. Stereotypes or people's orientation towards the irrelevance of a tradition that is hundreds of years old can begin to be reconstructed through the *Irung-Irung* Tradition because this tradition has proven to be successful in building awareness of the people of Cihideung Village for clean water and proper sanitation.

5. CONCLUSION

Based on the research above, it can be concluded that the *Irung-Irung* tradition carried out every year by residents of Cihideung Village, West Bandung Regency, contains moral messages and values in the form of expressions of gratitude to God for the spring that never recedes, respecting the spirits of ancestors, and strengthening the brotherhood ties between residents of Cihideung Village, as well as strengthening the mindset of Cihideung village residents to perpetuate awareness of environmental cleanliness, especially regarding the cleanliness of water and water channels, which impacts the quality of sanitation.

There are three elements of water awareness in the *Irung-Irung* tradition. First, the philosophical meaning of expressing gratitude to God implements the *Irung-Irung* tradition as a means for the Cihideung Village community to communicate the importance of keeping water clean to create a clean and healthy village environment. Second, the initial series of the Irung-Irung tradition in the form of carrying out community service to clean water sources and all water channels in Cihideung Village is a form of realization of the philosophical meaning of the *Irung-Irung* tradition to create clean water channels so that they are free from flood disasters. Third, participation from all levels of Cihideung Village society implies that hydrological educational messages can be passed on to the next generation. The existence of the *Irung-Irung* tradition aligns with efforts to realize the Sustainable Development Goals (SDGs). The *Irung-Irung* tradition is a form of community participation in Cihideung Village in realizing the sixth goal in the SDGs, namely related to water accessibility and proper sanitation by carrying out community service to clean water sources and water channels periodically to maintain water quality and cleanliness. Communities who participate in the *Irung-Irung* tradition as a tradition that contains ecological values can be a catalyst in efforts to pass on hydrological education to the next generation because this tradition is a manifestation of

local wisdom that remains relevant amidst the turbulence and dynamics of the times. It is also hoped that the *Irung-Irung* tradition can maintain its existence and become increasingly known to the general public as an environment that implements good water and sanitation management. More than that, it is hoped that the *Irung-Irung* tradition can open the door to opportunities for the local tourism sector, which echoes ecological messages to help the economy of the residents of Cihideung Village, West Bandung Regency.

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EVOLVING *HANGWURAN* CITY DEVELOPMENT MODEL THROUGH PARTIAL LEAST SQUARE APPROACH IN NORTH-CENTRAL NIGERIA

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ABSTRACT

The need for a paradigmatic shift in city development ideology has become increasingly evident over the years. In response to this need, the Hangwurian City Development Model was developed to establish a connection between the concepts of environmental awareness, urban governance, and management. This model also integrates sustainable urban development, urban liveability, and inclusive physical development. The research sets a critical objective of analyzing the significant levels of various indicator variables. The exploratory research utilized partial least squares (PLS) via SmartPLS to evaluate the variables, collecting quantitative data through the open data toolkit from three selected cities: Lokoja, Minna, and Lafia in North-Central Nigeria. The study sampled 843 respondents across the cities, randomly selected among residents aged 18 years and older, with a focus on household heads as the unit of measurement. The research findings indicate that most of the examined variables have Cronbach's Alpha above 0.7, and most of the retained variables have a significance value greater than or equal to 0.7. The average variance explained by the indicators was very substantial, with most falling within the 0.5 to 0.6 range. Therefore, the research recommends that, due to the significance of the indicators and the validity of the internal and external data, this model can be applied as a procedural framework to guide city development on a regional scale. Consequently, it was concluded that for city development to progress and evolve without the issues that Hangwurian city development aims to address, it must be approached through the interconnectedness and significance of environment, governance, sustainability, liveability, and inclusion.

Keywords: Environmental awareness; Hangwurian city development; Urban liveability; Inclusivity; Sustainability; Urban management and governance

1. INTRODUCTION

The development of urban spaces, especially in developing countries, has been characterized more by organic emergence than by the result of a defined planning style (Boonstra & Boelens, 2011). This type of urban development is also associated with uncoordinated and unplanned population expansion within cities (Dankani & Abubakar, 2016). The rate of this population growth continues to drive the demand for space for housing and other urban functions (Harvey, 2008). Several efforts have been implemented to manage the rapid urbanization of these cities and provide guidance for steadier urban growth (McCormick et al., 2013). Among these efforts to manage urban growth and development is the evolution of various urban development concepts, which include sustainability, liveability, inclusivity, environmental awareness, and inclusive development.

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Sustainable urban development, urban liveability, environmental awareness, inclusiveness, and urban governance all stem from the aspiration for a better urban environment. The detrimental effects of current lifestyles on the environment necessitate a more thorough study of human environmental behavior and social interactions (Correa Rodrigo, 2001; Mabee, 2004; Olsson et al., 2004; Sosa et al., 2008). Consequently, economic and social development strategies must incorporate environmental quality and sensitization monitoring within their objectives (Alcalá et al., 2006). Furthermore, the literature suggests that public programs and policies should foster participation in understanding the perspectives of community inhabitants regarding their knowledge, thoughts, and feelings about their environment (Starr et al., 2000).

Securing the participation of all community members is crucial for enhancing their quality of life and addressing environmental concerns both individually and collectively (Kos et al., 2003). The strategic application of governmental powers and policy objectives is essential to raise ecological awareness within the community (Sachs et al., 2019). A fundamental aspect of governance is its redefinition, moving away from historical connotations (Kjaer, 2023). Good governance is now perceived as a regulatory system that orchestrates the interactions between citizens and the state, grounded on principles that are widely recognized as vital to effective government (Howlett, 2019).

In the pursuit of "excellent governance," it is imperative to enhance "practically every aspect" of the public sector (Grindle, 2004). In recent years, many policymakers have focused on the socio-financial elements of governance reform, emphasizing the connection between these facets of governance and overall transformation (Hout, 2009). Hout and Robinson (2009) highlight a shift in governance ideology, moving away from merely "good governance" to the practical implications of governance. This shift involves an evolving understanding of the impact that power, politics, and behavioral tensions have when conceptualizing development outcomes and the strategies for mitigating these challenges within institutional and governance programs.

During the transition phase, a systematic assessment of environmental consciousness and urban governance is evident (Topal et al., 2020). This assessment serves as a crucible for urban growth, enhancing the city's sustainability, liveability, and inclusiveness (Krishnamurthy, 2019). Sustainable Development (SD) was established at the 1992 United Nations Conference on Environment and Development (UNCED), with Agenda 21 set as a universal goal for humanity (Mensah, 2019). Since then, SD has gained traction as a political ideal and goal at all levels, from international to national to local (Mair, 2012). The philosophy of sustainable development can be traced back to the 1960s when the links between economic growth, pollution, and environmental degradation were first recognized (Mensah, 2019; Mebratu, 1998).

Sustainable development (SD) not only promotes economic growth but also emphasizes the need to reconcile this growth with environmental protection (Ghisellini, Cialani & Ulgiati, 2016). SD challenges can be categorized broadly into two areas: improvement (to enhance conditions) and long-term viability (to maintain them) (Baumgartner & Ebner, 2010; Haberl et al., 2011). SD seeks a balance among environmental, economic, and lifestyle considerations (Goodland and Daly, 1996), typically analyzed in terms of these three dimensions.

The hallmarks of sustainable development include optimal quality of life and the preservation of the environment in its broadest biophysical and socioeconomic contexts (Quental et al., 2011). The future should hold no disadvantages. Environmental concerns, economic growth, and human reform are interwoven within a sustainable development framework that spans the globe and the decades (Imran, Alam, & Beaumont, 2014). Meanwhile, the European Commission (2002) focuses on the social and environmental aspects of development in politics, practice, and academia. In-depth analyses of sustainable development underscore urban liveability and inclusion as essential components of these efforts. The concept of liveability is an integral part of

planning (Balsas, 2004; Medayese et al., 2021a). Governments at all levels increasingly use the term "liveability" to articulate long-term objectives (Lowe et al., 2015). The ideal of "liveability" has been woven into a myriad of planning sub-disciplines, including transportation, community development, and resilience (Dianat et al., 2021; Medayese et al., 2021b). While the term "liveability" is frequently employed in planning documents, it is subject to a plethora of interpretations. Various definitions have been proposed, each highlighting distinct themes and characteristics (Istrate & Chen, 2022). However, most discussions of "liveability" eschew a definitive description, focusing instead on the application of key definitions. An understanding of what planners and communities mean by "liveability" can be gleaned from examining its usage.

Liveability can be summarized as an urban system that nurtures the physical, social, and mental well-being, as well as the personal development, of all its residents. It encompasses the creation of aesthetically pleasing urban spaces that act as conduits for the dissemination of religious and cultural values (Audretsch, Belitski & Korosteleva, 2021). Foundational concepts of this theme include equity, decency, accessibility, friendliness, engagement, and empowerment (Saxena, 2021). Cities that are friendly to people have always considered those social groups whose vision of a liveable city includes the preservation or restoration of these aspects (Routman, 2018). The liveability of a city is assessed based on three factors: Quality of Life, Liveable Communities, and Place Shaping (Lowe et al., 2015). Although the term "social misfits" was first introduced by Aalbers (2010) to describe a particular class of individuals, these individuals were labeled as "social misfits" due to a range of characteristics, including, but not limited to, "mentally and physically disabled, suicidal people, elderly invalids and abused children," as well as drug addicts, delinquents, single parents, households with multiple problems, marginalized and asocial individuals, among others (Lowe et al., 2015).

In response to the growing concern about social exclusion, efforts to promote social inclusion have emerged (Khan, Combaz & McAslan, 2015). Inclusion enhances the lifestyles of those marginalized by empowering individuals regardless of their age, gender, disability, color, ethnicity, religion, or economic position, providing them with more opportunities, access to resources, and a voice (Kapilashrami & Marsden, 2018). Thus, inclusion serves as both a means and an end (Dudley-Marling & Burns, 2014). To achieve social inclusion, it is necessary to remove barriers to community involvement and implement proactive inclusionary measures (Simplican et al., 2015). It is a political solution to the problem of exclusion, aiming to include and accept everyone while also promoting greater equality and tolerance (Kymlicka, 2010).

Beginning in the mid-1990s, a renewed interest in the state's role in development marked a significant departure from the neoliberal paradigm that had predominated for decades (Zadra, 2017). This approach, embodied in the Washington Consensus, reflected deep doubts about the state's ability to play a crucial role in development (Batley, 2002). However, it became clear that structural adjustment programs in developing nations, which supported the downsizing of the state, were not effective. Policymakers also recognized that the 'tigers' of East Asia had prospered due to the state's active encouragement of markets through industrial and financial policies. Decades later, Hout and Robison (1990) identified the first phase of donor governance strategy, focusing on improving government effectiveness and creating a legislative foundation for market-based development in the early half of the decade (Hout and Robison, 2009).

2. LITERATURE STUDY

2.1 The Historical Context of the Hangwurian Model

The Hangwurian development model is based on the SARChI Chair for Inclusive Cities' school of thought at UKZN. This ideological perspective emerged from the research chairperson, Hangwelani Magidimisha, and her doctoral researcher, Samuel Medayese (Medayese et al., 2021). The scientific collaboration between Professor Magidimisha (supervisor) and Dr. Medayese (mentee) is founded on the city model mentorship (Popoola, 2022). Popoola (2022) has discussed the significant role of mentors in establishing scientific identity and fostering a scientific school of thought.

The Hangwurian model seeks an ideal urban space that sustainably utilizes the environment through effective urban governance, ensuring that no elements of the city space are excluded during the development and promotion of liveability (Kasim et al., 2020; Lowe et al., 2015). The model's purpose is to facilitate city modifications that adhere to the principles of accessibility, equity, and moderated consumption patterns, guiding urban development and growth. It employs indicator variables such as environmental awareness, urban management and governance, sustainable urban development, urban liveability, and inclusive physical development to ensure that urban development avoids the spatial divides and deprivations commonly observed in African city spaces. This new paradigm in urban development recognizes the unique variations and strengths of a particular environment to promote its distinctive development. The term "Hangwurian" is derived from "Hangwelani," a Venda word meaning 'no worries' or 'hopeful.' The fundamental idea is to ensure that urban development is conceptualized in alignment with the strengths, weaknesses, opportunities, and threats inherent in the environment under development focus.

A pragmatic approach to city planning involves considering each site's unique characteristics to foster growth that is tailored to that specific locale. The term "Hangwurian" originates from "Hangwelani," a South African Venda word meaning "no worries" or "hopeful." The essence of this approach is to ensure that the SWOT analysis of the area in question is incorporated into the urban planning process.

The Hangwurian model, as a collaborative and descriptive urban analysis framework, draws on the strengths of several research works by Hangwelani Hope Magidimisha. For instance, Magidimisha and Chipungu (2023) highlighted the importance of inclusivity and the need to move away from xenophobic exclusionary tendencies, advocating for the inclusion of vulnerable groups. Her works and publications cover a range of issues related to inclusivity and urban development. The concept of a 'Hangwurian city' as a participatory urban space was emphasized in Medayese, Magidimisha, and Chipungu (2022). Additionally, Medayese and Magidimisha (2022) evaluated the Spatial Matrices of Urban Expansion in Lafia, North-Central Nigeria, serving as a pioneering work arguing for a development paradigm unique to the African city system, free from the biases of foreign ideals that characterize most existing urban development frameworks. Medayese and Magidimisha (2021) also acknowledged the challenges of urban liveability and the shortcomings of urban development in the African city context, while Medayese, Magidimisha, and Chipungu (2021) contended that the desired quality of life could act as a moderator in the relationship between liveable communities and place-shaping. The collective outcomes of these studies provided the impetus for a new approach in urban development modeling, with the partial least squares method offering a way to evolve an urban development model that aligns with the challenges and peculiarities of the African city system.

2.2 Conceptual Framework

Sustainable urban development, urban liveability, environmental awareness, inclusiveness, and urban governance are all outcomes of the aspiration for a better urban environment. A closer examination of human environmental behavior and social relationships is imperative due to the detrimental impacts of current lifestyles on the environment (Corrêa et al., 2006; Mabee, 2004; Olsson et al., 2004; Sosa et al., 2008). Economic and social development strategies must integrate environmental considerations, necessitating the monitoring of environmental quality and public awareness of environmental issues. The literature also suggests that public programs and policies promoting engagement require an understanding of the community's knowledge, thoughts, and feelings about their environment (Hart, 2013).

Community members' attitudes and values regarding their quality of life and solutions to environmental issues must be solicited (Kos et al., 2003). Enhancing the public's understanding of environmental concerns requires the successful application of political will and policy objectives. Redefining governance in the modern era is a crucial aspect of governance. Governmental systems are designed to regulate the interactions between the state and society, based on principles recognized as mutually interdependent. Governance is an expansive and inclusive term, and the pursuit of "good governance" depends on improvements across nearly all facets of the public sector (Grindle, 2004).

For many policymakers, the political-economic aspects of governance reform have been a priority since the dawn of the 21st century (Hout, 2009). Hout and Robison (2009) observed a growing recognition of the influence of power, politics, and social conflict on development outcomes and the challenges these present to existing institutional or governance programs. During the transition period, a heightened awareness of environmental consciousness and urban governance may be discerned. As it lies at the heart of urban growth, this focus helps ensure that the city's development is environmentally friendly, liveable, and inclusive for all residents. This approach was encapsulated in Agenda 21 at the United Nations Conference on Environment and Development (US Coordination Centre for the UN Conference on Environment and Development, 1992). The concept of sustainable development, established in 1992, was adopted as a political goal worldwide. To understand the origins of sustainable development, one must look back to the environmental movement of the 1960s and the recognized link between economic growth and environmental degradation.

Sustainable development centers on the human condition, distinguishing itself from other development forms by emphasizing economic growth while underscoring the need to balance such growth with environmental protection. Sustainable development is universally acknowledged to have two dimensions: development (improvement) and sustainability (maintenance). In planning and decision-making for sustainable development, it is essential to consider economic development, environmental protection, and social justice (Goodland & Daly, 1996). These three aspects are considered the pillars of sustainable development. When implemented effectively, sustainable development enhances well-being, protects the environment and resources in the broadest biophysical and socioeconomic sense, and ensures that future generations do not suffer from present decisions. Sustainable development must integrate environmental concerns with economic development over time and space. It also highlights the social and ecological dimensions in politics, practice, and research. In examining sustainable development in detail, the quality of the urban environment and social inclusion are crucial elements.

Liveability has become a cornerstone of the planning process, with governments at all levels using the term to articulate their long-term objectives. Beyond transportation, liveability is embraced across a spectrum of planning sub-disciplines and is a key consideration in industries

related to subjective well-being and quality-of-life research. While "liveability" is a common term in planning documents, it encompasses a diverse range of meanings, leading to a rich tapestry of topics and characteristics. However, its technical definition often remains elusive, with its practical meaning derived from common usage. Understanding how liveability is applied offers planners and communities valuable insights into their collective vision of a liveable city.

Liveability can be summarized as an urban framework that nurtures the physical, social, and emotional well-being, as well as the personal development, of its inhabitants. It involves crafting aesthetically pleasing urban spaces that facilitate the dissemination of religious and cultural values. Foundational principles such as equality, decency, accessibility, friendliness, participation, and empowerment guide this concept. Cities that are attuned to the needs of people include social groups whose vision of a liveable city is one where these principles are maintained or reinstated. The evaluation of a city's liveability can be based on three criteria: place shaping, quality of life, and liveable communities. The terms "inclusion" and "exclusion," coined by René Lenoir in 1974, describe the challenges faced by various demographics, including those with disabilities, the elderly, abused children, addicts, and other marginalized individuals, highlighting the need for inclusive urban development (Banerjee, 2016).

Efforts to promote social inclusion have been a response to the growing concerns about social exclusion. Social inclusion aims to empower those disadvantaged by age, gender, disability, race, ethnicity, origin, religion, or socioeconomic status by providing more opportunities, access to resources, and a voice in society. Achieving social inclusion involves removing barriers to societal participation and actively implementing inclusive measures. It is a deliberate process that seeks to promote social equality and embrace all individuals.

Since the mid-1990s, there has been a renewed interest in the state's role in development, marking a departure from the neoliberal paradigm that had dominated previously. This shift was met with skepticism regarding the state's capacity to significantly influence development (Batley et al., 2002). Policymakers recognized that the rapid growth of the East Asian "tigers" was a result of the state's proactive industrial and financial policies. According to Hout and Robison (1990), donor governance policy, which began in the early 2000s, focused on improving government efficiency and necessitated technocratic reforms to support market-based development (Hout & Robison, 2009).

To evaluate the ideological relationship between ecological consciousness and urban governance, we employ environmental knowledge and environmental motivation/values as indicators of environmental awareness. There are numerous indicators of urban governance, such as population management, family planning, credit facilities, and information flow. When these indicators are integrated, they can help balance the development flow between sustainable urban development—measured by economic prosperity, social cohesion, and environmental consideration—and urban liveability, which is measured by the quality of life for residents and the creation of livable communities. A careful examination of the complex interaction between these concepts has shown that the ability to create a sustainable consumption pattern for both human and natural resources, improve access to the city, and ensure equity within it, is key to a paradigm shift toward new urban thinking. This shift can lead to a city free of worries and concerns. The Hangwurian Model has been suggested for physical and urban development, and Figure 1 depicts the path connectivity of this proposed concept.

According to environmental knowledge and motivation/values, the ideological connection between environmentalism and urban governance is measured. In contrast, indicators of urban management such as population control, family planning, credit availability, and information flow, among others, can be used to balance the development tides between the three pillars of sustainable urban development: economic prosperity, social cohesion, and environmental

consideration. Critical analysis has therefore established, through a careful appraisal of the depth of relationships and tension within these concepts, that the ability to develop an acceptable consumption pattern of both human and natural resources, enhance access to the city, and ensure equity within the city holds the ace for a paradigmatic shift to new urban thinking. This can deliver a city without worries. Figure 1 examines the path connectivity diagram of the Hangwurian Model proposed for physical and urban development.

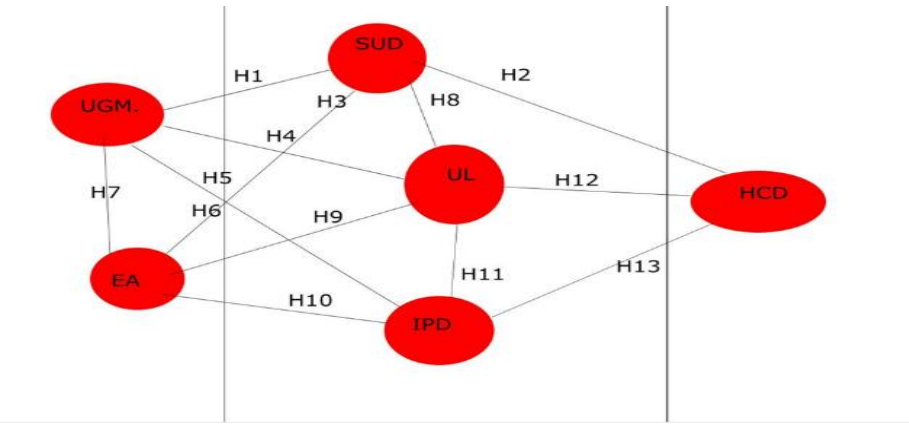

Figure 1 *Hangwurian* City Development Path Diagram
(Source: Author's Simulation)

Consumption patterns, access to the city, and equity constitute the three foundational pillars of the Hangwurian City concept—an Anglicized version of the Xhosa word "Hangwelani." By leveraging policymakers and urban gatekeepers as catalysts, this paradigm shift in development focus aims to transform African cities into spaces that exude value and competitiveness. It seeks to resolve conflicts within the African city system by fostering development at a pace commensurate with available resources and enhancing the acceptability of development initiatives. The Hangwurian City Development (HCD) paradigm in North-Central Nigeria is the focal point of this research. The primary objectives are to determine the predictive significance of various indicators, analyze the significance levels of the indicator variables, and ascertain the importance-performance index of the evolved variables of HCD.

3. METHODOLOGY

The development of a model hinges on a critical element: empirical testing of theories and notions by scholars in fields such as Planning. The incorporation of Structural Equation Modeling (SEM) as a causal simulation model has broadened its application, as noted by Fernandes (2012), Hulland (1999), and Hair et al. (2012). SEM integrates first-generation methods like principal components and linear regression analysis, connecting them in a comprehensive framework (Fornell, 1982). Researchers increasingly investigate complex hypotheses, concepts, and models to estimate composite relationships between variables (Chin, 2010; Robins, 2012).

A range of SEM-based techniques for modeling data includes covariance-based SEM (CB-SEM) and variance-based Partial Least Squares SEM (PLS-SEM) (Hair et al., 2012; Hair et al., 2013). CB-SEM is a confirmatory technique that estimates correlations between variables based on theoretical parameters, ensuring the model's proposed covariance matrix aligns more closely with the sample covariance matrix (Hair et al., 2012). In contrast, PLS-SEM adopts a predictive strategy, focusing on the model's endogenous target constructs, such as the (R2 value), to extend explained variance (Hair et al., 2012). Statistical approaches like regressions and structural equation modeling have been employed to validate models concerning sustainability and

livability (e.g., Ankrah, 2007; Isik et al., 2010). PLS-SEM, a multidimensional technique, can evaluate multiple outcomes and predictors, whether continuous or categorical.

PLS-SEM operates under flexible normality assumptions about distribution and is prediction-oriented with a variance foundation, enabling maximum likelihood-based SEM estimations (Hair et al., 2012). Similar to SEM, it is grounded in Ordinary Least Squares (OLS), which allows for use with smaller sample sizes while still achieving robust statistical prediction power (Nandakumar, 2008; Reinartz et al., 2009). Direct causal paths can be estimated simultaneously through a sequence of path or structural equations, providing an overall evaluation of the model's fit (Goodness of Fit, GoF). Unlike CB-SEM, PLS-SEM has no identification issues, which can severely limit the application of CB-SEM (Hair et al., 2011). SmartPLS (Version 3.0 (M3)) is utilized to analyze PLS-SEM data generated by the SmartPLS software.

As an exogenous or independent variable, the city's citizens significantly influenced the model's evolution. The four endogenous or dependent factors are city demographics, resource availability, environmental knowledge, and urban management strategies. An exogenous variable is one whose variation is explained by factors not included in the model and the variance in other variables. Conversely, an endogenous variable is affected by one or more variables within the model (Lleras, 2005). Reflective indicators were applied to measure the constructs in the study, following the recommendations of Gudergan et al. (2008).

The data sources for this research were obtained from direct field data collection using a structured questionnaire administered in three selected cities in North-Central Nigeria as a test case for the conceptual framework's validation. The questionnaire elicited responses from urban residents in the selected cities, who were asked to rank the identified indicators of the conceptual framework using a 5-point Likert scale. This facilitated the application of partial least squares analysis. The research questionnaire was instrumental in obtaining the empirical and quantitative analysis required to address the research question on the development indicators, which measure the constructs identified in the conceptual framework, as shown in Table 1.

The primary aim of the questionnaire was to simplify the response process for participants, thereby enhancing the overall response rate. Creswell (2003) emphasizes that the correct development of a questionnaire is crucial for gathering accurate data. Easterby-Smith et al.'s (2012) five design principles informed the design of this study's questionnaire. To ensure adherence to these principles, the questionnaire was reviewed by four other researchers specializing in sustainability and liveability. Each question was evaluated using a set of 5-point Likert scales, as outlined by Holt (2014). The survey comprised eight distinct sections.

In the questionnaire design, the constructs employed for the research were derived from a comprehensive review of literature encompassing sustainable development, inclusive development, and urban liveability. These constructs included all the variables present in the conceptual model. Table 1 presents the constructs assessed in the questionnaire alongside the research from which the scales were adapted.

An exhaustive literature analysis, including sources outside of the realms of sustainable development, inclusive development, and urban liveability, provided the foundational concepts utilized in the research that informed the questionnaire design. The conceptual model's variables were all part of these constructs. Table 1 illustrates the research that provided the scales and the constructs that were tested in the survey.

Table 1 Constructs for the Study and Sources of the Measurement Items

Constructs	Sub-Constructs	Number of Issues	Origins of the Measurement Indicators
Sustainable Urban Development	Economic Prosperity	5	Rinne et al. (2011); Pizzoli & Gong (2007)
	Social Inclusion	4	
	Demographic Changes	3	
	Public Health	2	
	Climate Change and Energy	2	
	Sustainable Consumption and Production	3	
	Natural Resources	4	
	Sustainable Transport	3	
	Good Urban Governance	3	
	Global Partnerships	3	
Environmental Awareness	Motivation, Values, and Attitudes	4	Mei et al. (2016)
	Environmental Knowledge	4	
	Skills and Abilities	3	
Inclusive Physical Development	Inclusiveness	7	UN-Habitat (2016)
	Safety	8	
	Resilience	4	
	Sustainability	9	
Urban Management (Mgt.) and Governance	Population	2	Flood (1999); Webster (2004)
	Family Planning	2	
	Youth Employment	2	
	Hospital Network Services	2	
	Credit Facilities and Funds for the Development of Rural Areas		
Urban Liveability	Quality of Life	4	Aulia (2016)
	Liveable Communities	7	
	Place Making	5	

Source: Author's Compilation (2021)

The sample frame for this research encompassed the total population of the purposively selected cities, which includes the residents of Lafia in Nasarawa State, Lokoja in Kogi State, and Minna in Niger State. Furthermore, the primary unit of measurement was the households within these cities. The total population of the cities was divided by the average household size to calculate the number of households. Additionally, the research adopted a population projection method to estimate the growth of the study cities' populations from 1991 to 2001, 2002 to 2012, and 2013 to 2019. The population distribution and the sample drawn for the research are detailed in Table 2.

$$P = P_o\left(1 + \frac{r}{100}\right)n$$

where P =projected population; n = years interval; P_o = base year population; r = growth rate.

Table 2 Sample Frame Structure for the Research

S/No	State	City	1991 Census Figures	Projected Population 1991 - 2001	Projected Population 2002 - 2012	Projected Population 2013 - 2019	Total Number of Households = Total Population/5.4
1	Nasarawa	Lafia	240,656	329,756	451,845	563,315	104,318
2	Niger	Minna	230,169	315,387	432,143	538,748	99,768
3	Kogi	Lokoja	82,483	113,018	154,857	193,060	35,752
	Total		**553,308**	**758,161**	**1,038,845**	**1,295,123**	**239,838**

Although the area has a population of 1,295,123, the household serves as the unit of measurement for this research. According to the NPC (2011), the average household size in each city is 5.4 people. Consequently, a total of 239,838 households are considered for the study. The research sample size was determined by accounting for all the households in the city. The appropriate sample size for this study was calculated using an online sample size calculator, with a 35 percent response rate, a 95 percent confidence level, and a confidence interval of 1–5. Therefore, the sample size, which corresponds to the total number of questionnaires distributed for the study across the region, is 843.

This research in achieving the *Hangwurian* City development relied on six (6) essential assumptions:

- Urban governance, administration, and environmental consciousness must be the guiding principles of city growth.
- Environmental knowledge, motivations, and values are used to gauge environmental consciousness.;
- Urban management and governance must be evaluated through the lenses of credit facilities, population control, and hospital network systems.;
- Urban liveability, inclusive physical development, and sustainable development must all be balanced;
- The three concepts are as follows: liveable communities, quality of life, and place-shaping for urban liveability; economic prosperity, environmental considerations, and social cohesion for sustainable urban development; safety, resilience, and equity/justice as metrics for inclusive physical development; and
- It is necessary to gauge the New Order (Hangwurian Model) using metrics related to equity, access to the City, and consumption patterns.

4. DATA ANALYSIS AND RESULTS

To investigate the hypothetical paths proposed in this research (Ringle et al., 2005), we utilized SmartPLS version 3.3 software to perform Partial Least Squares (PLS) analysis and obtain standard regression coefficients for the paths connecting the components, employing the structural equation modeling technique (Croteau and Bergeron, 2001). PLS was chosen for this investigation due to its reliance on the least squares estimation method. This approach allows for identifying latent, formative or reflective variables (Podsakoff et al., 2006). A component-based approach implies that sample sizes and residual distributions are subject to minimal restrictions (Hair et al., 2012; Elbanna et al., 2013).

Moreover, latent variables can be modeled, and structural models can be examined concurrently using PLS-SEM (Elbanna et al., 2013). However, as this study is exploratory in nature, further testing is required. Utilizing this methodology is one of the most widely accepted ways to develop new theories. Additionally, this tool is capable of assessing the impact of common method biases on thought processes (Podsakoff et al., 2003). This strategy has been extensively employed by researchers in marketing and traditional management fields (Elbanna et al., 2013; Hair et al., 2014; Sarstedt et al., 2014).

4.1 Measurement Model

Exploratory factor analysis was employed to ascertain the optimal number of indicators to retain for each of the six latent variables in this study: Hangwurian City Development (HCD), Urban Governance (UMG), Sustainable Urban Development (SUD), Inclusive Physical Development (IPD), Environmental Awareness (E.A.), and Urban Liveability (URL). This process enabled the researchers to pinpoint the most suitable indicator for each construct. The URL construct encompassed twenty-two indicators for urban administration and governance, ten for SUD, sixteen for IPD, eleven for E.A., and fourteen for HCD. In evaluating the measurement model based on the PLS results, it is essential to consider factor loadings, indicator reliability, discriminant validity, convergent validity, and internal consistency reliability.

The exploratory study utilized squared factor loadings, with most indicators approaching (0.7) (Oke and Ogunsemi, 2016; Table 2). However, as indicated in Table 3, they surpassed the exploratory study's minimum requirement of (0.4) (Holland, 1999). The model's component latent reliability ranged from (0.824) to (0.925), exceeding the accepted threshold of (0.70) for internal consistency of individual constructs. The composite elements of the model demonstrated adequate internal consistency and reliability. Convergent validity testing of the model showed that the average variance explained (AVE) was significantly above (0.5), as detailed in Table 3, corroborating the findings of Bagozzi and Yi (1988).

Table 3 Model Path Analysis for *Hangwurian* City Development in North-Central Nigeria

Latent Variable	Indicators	Loadings	Indicator Reliability (i.e., loadings2)	Composite Reliability	R^2	AVE	Cronbach's Alpha
Access to the City	ATC 204	0.743	0.522	0.888	0.911	0.614	0.843
	ATC 208	0.785	0.616				
	ATC 209	0.746	0.557				
	ATC 210	0.825	0.681				
	ATC 211	0.816	0.666				
	ATC 211	0.743	0.552				
Credit Facilities	CRF 141	0.749	0.561	0.849	0.942	0.548	0.766
	CRF 142	0.788	0.621				
	CRF 143	0.830	0.689				
	CRF 144	0.841	0.707				
	CRF 145	0.833	0.694				
Consumption Pattern	CSP 192	0.787	0.619	0.826	0.399	0.614	0.684
	CSP 193	0.819	0.671				
	CSP 196	0.742	0.551				
Economic Prosperity	ECP 3	0.786	0.618	0.882	0.798	0.653	0.822
	ECP 6	0.857	0.734				
	ECP 8	0.731	0.534				
	ECP 9	0.852	0.726				
	ECP 9	0.786	0.617				
Environment	ENV 36	0.850	0.723	0.882	0.725	0.714	0.800
	ENV 39	0.857	0.734				
	ENV 40	0.827	0.684				

Environmental Knowledge	ENVK 169	0.768	0.590	0.914	0.909	0.570	0.892
	ENVK 170	0.750	0.563				
	ENVK 175	0.743	0.552				
	ENVK 182	0.763	0.582				
	ENVK 185	0.784	0.615				
	ENVK 186	0.804	0.646				
	ENVK 187	0.714	0.510				
	ENVK 189	0.713	0.508				
Equity/Justice	EQJ 54	0.763	0.582	0.852	0.453	0.589	0.768
	EQJ 55	0.769	0.591				
	EQJ 56	0.773	0.598				
	EQJ 57	0.766	0.587				
Equity	EQY 213	0.801	0.642	0.864	0.736	0.613	0.791
	EQY 214	0.780	0.609				
	EQY 215	0.789	0.623				
	EQY 216	0.762	0.581				
Hospital Network Services	HNS 151	0.796	0.634	0.891	0..309	0.577	0.803
	HNS 153	0.786	0.618				
	HNS 154	0.797	0.635				
	HNS 155	0.791	0.626				
Liveable-Communities	LVC 102	0.708	0.501	0.871	0.588	0.628	0.762
	LVC 103	0.741	0.549				
	LVC 105	0.770	0.593				
	LVC 106	0.821	0.674				
Motivation and Value	MVA 162	0.807	0.651	0.846	0.903	0.579	0.905
	MVA 163	0.818	0.669				
	MVA 164	0.793	0.629				
	MVA 165	0.830	0.689				
	MVA 166	0.790	0.624				
	MVA 167	0.792	0.627				
	MVA 168	0.753	0.567				
Place Shaping	PLS 112	0.809	0.654	0.925	0.761	0.637	0.756
	PLS 113	0.812	0.659				
	PLS 114	0.835	0.697				
Population	POP 127	0.822	0.676	0.859	0.403	0.671	0.740
	POP 128	0.802	0.643				
	POP 129	0.809	0.654				
Quality of Life	QoL 93	0.837	0.700	0.852	0.625	0.658	0.689
	QoL 96	0.751	0.564				
	QoL 97	0.751	0.564				
Building Resilience	RES 73	0.837	0.701	0.824	0.907	0.609	0.871
	RES 74	0.751	0.564				
	RES 75	0.811	0.658				
	RES 76	0.830	0.689				
	RES 78	0.709	0.503				
	RES 84	0.695	0.483				
Safety	SAF 67	0.756	0.572	0.903	0.739	0.609	0.724
	SAF 69	0.817	0.667				
	SAF 72	0.829	0.687				
Social	SOC 16	0.766	0.587	0.843	0.900	0.642	0.886
	SOC 17	0.816	0.666				
	SOC 18	0.829	0.687				
	SOC 19	0.823	0.677				
	SOC 21	0.771	0.594				
	SOC 22	0.783	0.613				

Source: Author's Analysis (2021)

4.2 Construct Reliability and Validity

Discriminant validity in PLS analysis can be assessed using the criteria outlined in Table 3. Generally, reflective constructs are expected to explain more variance than latent variables, and items should load more heavily on their associated constructs than others (Elbanna et al., 2013). As depicted in Table 3, the loadings for all indicators of latent variables exceed their cross-loadings. The AVEs of the constructs demonstrate greater diversity within their items compared to other constructs. Consequently, a valid and reliable measurement model has been established, which can be utilized to assess the structural model's predictive and explanatory power.

Convergent validity is indicated by multiple items measuring the same construct (Hair et al., 2014). The convergent validity of the measurements in this study was evaluated using external loadings and the average variance extracted (AVE) value. The AVE values should be at least (0.5) if the latent variable explains more than half of the variance in its indicators (Hair et al., 2010). In our analysis, we excluded any loadings below (0.5). The AVE and composite reliability (C.R.) targets were exceeded with ease (refer to Table 3 for details).

In addition, the validity of discriminant, convergent, and composite reliability (C.R.) hypotheses was tested to ascertain the uniqueness of each construct (Hair et al., 2017). According to Fornell and Larcker's criterion (1981), the square root of the average variance extracted (AVE) should be greater than its highest correlation with any other construct. Assessments that adhere to the Fornell and Larcker criteria demonstrate sufficient discriminant validity. However, when the indicator loadings of the constructs are only marginally different, Hair et al. (2016) suggest that this criterion may perform poorly. As an alternative, Henseler, Ringle, and Sarstedt (2015) propose the use of the heterotrait-monotrait (HTMT) ratio.

The HTMT measures the average heterotrait-heteromethod correlation in contrast to the average monotrait-heteromethod correlation. It represents a moderate association between heterotraits and heteromethods, i.e., the mean of all correlations of indicators measuring different constructs. The HTMT statistics and the Fornell-Larcker Criterion data are presented in Tables 4 and 5. The Fornell-Larcker Criterion statistic of (0.845) falls below the minimal threshold of (0.850). However, the HTMT's confidence interval does not include (0) when bootstrapping with a consistent PLS approach, indicating good discriminant validity. Consequently, this research confirms that the model's construct validity is robust.

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Table 4 Fornell-Lacker Criterion for Discriminant Validity

	ATC	CRF	CSP	EA	ECP	ENV	ENVK	EQJ	EQY	HCDM	HNS	IPD	LVC	MVA	PLS	POP	QoL	RES	SAF	SOC	SUD	UMG	URL
ATC	**0.784**																						
CRF	0.291	**0.741**																					
CSP	0.617	0.226	**0.783**																				
EA	-0.180	-0.328	-0.163	**0.738**																			
ECP	-0.175	-0.238	-0.089	0.260	**0.808**																		
ENV	-0.136	-0.223	-0.068	0.243	0.665	**0.845**																	
ENVK	-0.177	-0.313	-0.149	0.953	0.265	0.252	**0.755**																
EQJ	0.206	0.259	0.170	-0.157	-0.092	-0.076	-0.151	**0.768**															
EQY	0.730	0.231	0.549	-0.140	-0.122	-0.078	-0.128	0.159	**0.783**														
HCDM	0.954	0.287	0.631	-0.169	-0.167	-0.123	-0.160	0.220	0.858	**0.760**													
HNS	0.199	0.532	0.170	-0.203	-0.114	-0.105	-0.183	0.232	0.145	0.184	**0.793**												
IPD	0.228	0.313	0.161	-0.184	-0.186	-0.156	-0.186	0.673	0.171	0.230	0.313	**0.786**											
LVC	0.195	0.273	0.147	-0.160	-0.093	-0.081	-0.147	0.249	0.159	0.197	0.248	0.214	**0.761**										
MVA	-0.164	-0.310	-0.161	0.950	0.229	0.210	0.812	-0.147	-0.137	-0.161	-0.203	-0.164	-0.157	**0.798**									
PLS	0.173	0.363	0.145	-0.278	-0.183	-0.139	-0.255	0.222	0.128	0.172	0.254	0.236	0.592	-0.274	**0.819**								
POP	0.175	0.621	0.195	-0.282	-0.158	-0.167	-0.267	0.231	0.133	0.165	0.480	0.295	0.270	-0.269	0.324	**0.811**							
QoL	0.187	0.281	0.149	-0.201	-0.165	-0.142	-0.189	0.232	0.136	0.186	0.219	0.221	0.629	-0.193	0.635	0.266	**0.781**						
RES	0.232	0.307	0.146	-0.189	-0.195	-0.156	-0.192	0.661	0.162	0.226	0.299	0.952	0.217	-0.166	0.236	0.300	0.211	**0.781**					
SAF	0.178	0.279	0.143	-0.152	-0.139	-0.113	-0.151	0.641	0.151	0.194	0.274	0.860	0.193	-0.137	0.220	0.231	0.225	0.730	**0.801**				
SOC	-0.120	-0.204	-0.066	0.266	0.763	0.725	0.277	-0.038	-0.093	-0.122	-0.064	-0.115	-0.066	0.228	-0.157	-0.154	-0.143	-0.115	-0.078	**0.798**			
SUD	-0.155	-0.241	-0.081	0.285	0.893	0.851	0.294	-0.070	-0.108	-0.150	-0.099	-0.162	-0.086	0.247	-0.177	-0.175	-0.165	-0.165	-0.116	0.948	**0.738**		
UMG	0.293	0.971	0.228	-0.316	-0.230	-0.211	-0.300	0.267	0.233	0.289	0.556	0.325	0.292	-0.302	0.358	0.634	0.288	0.320	0.288	-0.194	-0.231	**0.799**	
URL	0.211	0.365	0.163	-0.259	-0.195	-0.142	-0.243	0.255	0.158	0.208	0.265	0.250	0.767	-0.249	0.872	0.339	0.791	0.249	0.230	-0.165	-0.186	0.375	**0.763**

Source: Author's Analysis (2021)

Table 5 Heterotrait-Monotrait Ratio (HTMT) for measuring Discriminant Validity

	ATC	CRF	CSP	EA	ECP	ENV	ENVK	EQJ	EQY	HCDM	HNS	IPD	LVC	MVA	PLS	POP	QoL	RES	SAF	SOC	SUD	UMG	URL
ATC																							
CRF	**0.359**																						
CSP	0.812	**0.314**																					
EA	0.204	0.392	**0.203**																				
ECP	0.209	0.324	0.119	**0.296**																			
ENV	0.167	0.297	0.092	0.280	**0.817**																		
ENVK	0.207	0.386	0.190	1.043	0.309	**0.297**																	
EQJ	0.254	0.331	0.235	0.183	0.115	0.098	**0.179**																
EQY	0.890	0.279	0.740	0.158	0.143	0.097	0.150	**0.197**															
HCDM	1.119	0.345	0.826	0.187	0.194	0.148	0.182	0.270	**1.037**														
HNS	0.241	0.652	0.228	0.228	0.140	0.128	0.211	0.295	0.181	**0.221**													
IPD	0.262	0.379	0.208	0.201	0.213	0.186	0.208	0.820	0.203	0.265	**0.372**												
LVC	0.240	0.338	0.200	0.172	0.115	0.099	0.160	0.321	0.199	0.241	0.312	**0.258**											
MVA	0.190	0.377	0.205	1.027	0.266	0.246	0.899	0.176	0.158	0.182	0.234	0.183	**0.175**										
PLS	0.217	0.470	0.203	0.332	0.229	0.183	0.313	0.292	0.163	0.213	0.324	0.292	0.771	**0.334**									
POP	0.223	0.793	0.274	0.337	0.200	0.217	0.327	0.306	0.172	0.207	0.620	0.366	0.346	0.328	**0.431**								
QoL	0.232	0.372	0.206	0.246	0.205	0.178	0.234	0.308	0.175	0.228	0.289	0.274	0.853	0.245	0.876	**0.364**							
RES	0.266	0.373	0.183	0.203	0.222	0.180	0.211	0.811	0.190	0.256	0.354	1.076	0.265	0.183	0.294	0.371	**0.264**						
SAF	0.224	0.367	0.205	0.188	0.184	0.149	0.190	0.857	0.199	0.247	0.352	1.067	0.257	0.174	0.301	0.314	0.314	**0.907**					
SOC	0.141	0.271	0.094	0.292	0.890	0.861	0.312	0.059	0.108	0.139	0.085	0.134	0.082	0.255	0.192	0.190	0.169	0.135	**0.113**				
SUD	0.176	0.308	0.106	0.306	1.021	0.986	0.323	0.090	0.122	0.166	0.118	0.179	0.101	0.269	0.211	0.209	0.191	0.180	0.150	**1.044**			
UMG	0.338	1.114	0.295	0.344	0.265	0.249	0.333	0.324	0.274	0.331	0.656	0.371	0.342	0.336	0.435	0.784	0.356	0.364	0.359	0.217	**0.251**		
URL	0.264	0.476	0.225	0.305	0.243	0.181	0.293	0.334	0.198	0.256	0.335	0.306	0.974	0.301	1.139	0.450	1.049	0.306	0.311	0.198	0.218	**0.455**	

Source: Author's Analysis (2021)

4.3 Structural Model Results

It is now appropriate to test the posited hypotheses using the results from the validated structural model. Path coefficients in the PLS model were interpreted analogously to beta values in regression analysis. Mooi and Sarstedt (2011) and Sarstedt et al. (2014) advised testing the model for collinearity issues before estimating path coefficients using ordinary least squares regression. Hair et al. (2014) noted that collinearity in these analyses could indicate bias. Consequently, following Wong (2013) and Sarstedt et al. (2014), we examined the potential linkage between the two constructs. A multiple regression analysis, with latent variable scores serving as predictors, was conducted to determine if collinearity issues within the internal model could be mitigated by constructing independent variables from the external latent variables—specifically, Environmental Awareness (E.A.), Urban Governance (UMG), Sustainable Urban Development (SUD), Urban Liveability (URL), and Inclusive Physical Development (IPD). Conversely, Hangwurian City Development (HCD) was treated as the dependent variable.

Hangwurian **Model Path Coefficient**

Path coefficients in the PLS model were interpreted in a manner akin to beta values in standard regression analysis. Given that path coefficients are derived using ordinary least squares regression, it was recommended that collinearity be assessed beforehand. Hair et al. (2014) posited that collinearity in these results could suggest bias. Therefore, we examined the potential linkage between constructs in line with Wong (2013) and Sarstedt et al. (2014). The exogenous latent variables—Urban Liveability (URL), Sustainable Urban Development (SUD), Environmental Awareness (E.A.), and Urban Governance (UMG)—were operationalized as independent variables using latent variable scores to investigate collinearity issues within the inner model.

The role of these variables was primarily explanatory. Figure 3 illustrates the relationships between the various exogenous latent factors and their impact on Hangwurian City Development (HCD). Research has associated the growth of Hangwurian City with factors such as environmental consciousness, effective urban administration and governance, high-quality urban living, sustainable urban development, and inclusive physical development (IPD), as well as their collective influence on HCD. Pathways starting from E.A. and leading to HCD and UMG were explored to understand these relationships.

It appears that the hypothesised path of Access to the City (ATC) and Consumption Pattern (CSP) to HCD (Path = 0.63; t = 30.621; p 0.000), as well as the hypothesised path of Equity (EQY) and Path = 0.888 to HCD (Path = 85.662, and p0.000, respectively) to HCD, are both supported. As depicted in Table 6 and Figure 2, these were the hypothesised routes for Hangwurian City Development and its endogenous latent factors. The first three theorised routes for HCD and its endogenous factors have been examined. In addition to the path coefficient, T-statistics, and P-value, the Table also includes other variable analyses between the exogenous and endogenous variables. As a result, the alternative hypothesis supported by the path coefficients for the exogenous latent variables in North Central Nigeria was rejected.

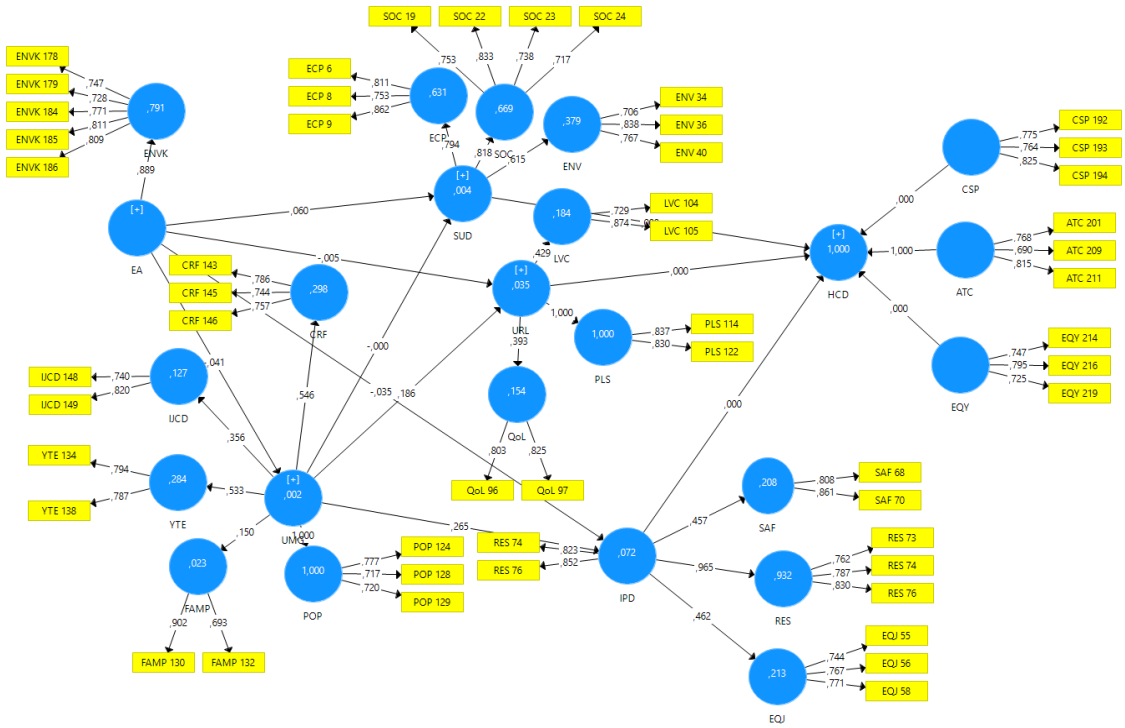

Figure 2 Path Coefficient and Analysis

Table 6 Path Coefficients

Variable Label	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statiistics (|O/STDEV|)	P Values	Decision
EA -> ENVK	0.953	0.954	0.004	255.691	0.000	Supported
EA -> HCD	-0.086	-0.086	0.035	2.439	0.015	Supported
EA -> MVA	0.950	0.951	0.004	258.618	0.000	Supported
EA -> UMG	-0.183	-0.183	0.032	5.684	0.000	Supported
HCD -> ATC	0.954	0.955	0.003	299.267	0.000	Supported
HCD -> CSP	0.631	0.634	0.021	30.621	0.000	Supported
HCD -> EQY	0.858	0.858	0.010	85.662	0.000	Supported
IPD -> EA	-0.099	-0.097	0.033	3.002	0.003	Supported
IPD -> EQJ	0.673	0.674	0.020	33.598	0.000	Supported
IPD -> RES	0.952	0.952	0.003	368.881	0.000	Supported
IPD -> SAF	0.860	0.860	0.009	92.828	0.000	Supported
IPD -> UMG	0.212	0.210	0.034	6.237	0.000	Supported
IPD -> URL	0.226	0.224	0.035	6.541	0.000	Supported
SUD -> EA	0.233	0.236	0.036	6.542	0.000	Supported
SUD -> ECP	0.893	0.893	0.008	109.702	0.000	Supported
SUD -> ENV	0.851	0.852	0.013	67.109	0.000	Supported
SUD -> SOC	0.948	0.949	0.004	253.664	0.000	Supported
SUD -> UMG	-0.097	-0.100	0.032	3.026	0.003	Supported
SUD -> URL	-0.149	-0.151	0.034	4.399	0.000	Supported
UMG -> CRF	0.971	0.971	0.002	530.053	0.000	Supported
UMG -> HCD	0.262	0.265	0.035	7.427	0.000	Supported
UMG -> HNS	0.556	0.557	0.027	20.585	0.000	Supported
UMG -> POP	0.634	0.636	0.025	25.612	0.000	Supported
URL -> EA	-0.191	-0.193	0.032	5.917	0.000	Supported
URL -> LVC	0.767	0.769	0.015	52.360	0.000	Supported
URL -> PLS	0.872	0.873	0.008	103.716	0.000	Supported
URL -> QoL	0.791	0.792	0.012	64.851	0.000	Supported
URL -> UMG	0.256	0.256	0.036	7.109	0.000	Supported

Source: Author's Analysis (2021)

4.4 Discussion

The study examined the validity of factor loadings and indicator reliability, as well as the reliability of internal consistency and convergent validity. The indicators demonstrated values near the acceptable minimum of (0.7) (Oke and Ogunsemi, 2016). Although the significance level for this exploratory study was set at (0), the results were deemed significant as they exceeded (0.4) (Hulland, 1999). The model's component latent reliability ranged from (0.824) to (0.925), surpassing the acceptable threshold of (0.70) for internal consistency of individual constructs. The composite elements of the model exhibited adequate internal consistency and reliability. Furthermore, average variance explained (AVE) values greater than (0.5) were in line with the model's validity, as suggested by Bagozzi and Yi (1988).

PLS analysis assesses discriminant validity using two key criteria. Typically, reflective constructs should explain more variance than latent variables, and items should have stronger loadings on their constructs than others (Elbanna et al., 2013). The indicators' loadings for latent variables are higher than their cross-loadings, indicating that the AVEs of the constructs exhibit a higher degree of variation within their items compared to other constructs. Therefore, the measurement model presented here possesses the necessary validity and reliability to evaluate the structural model's predictive and explanatory power.

Convergent validity refers to items measuring the same construct (Hair, Hult, Ringle, & Sarstedt, 2014). The convergent validity of the measures in this study was assessed using the average variance extracted (AVE) value and external loadings. The AVE values should be at least (0.5) if the latent variable accounts for more than 50% of the variance in its indicators (Hair et al., 2010). Loadings below (0.5) were excluded, resulting in final AVE and composite reliability (C.R.) values exceeding the recommended thresholds of (0.5) and (0.7), respectively.

To determine the uniqueness of a construct, the study examined the validity of convergent, discriminant, and C.R. measures (Hair et al., 2017). Fornell and Larcker (1981) state that a crucial criterion is that the square root of AVE should be greater than the highest correlation with any other construct. Assessments adhering to the Fornell-Larcker criterion demonstrate adequate discriminant validity. However, when the variation in indicator loadings of constructs is minimal, this criterion may not be sufficient (Hair et al., 2016). The Heterotrait-Monotrait (HTMT) ratio proposed by Henseler et al. (2015) is recommended for a more robust assessment. The HTMT measures the average heterotrait-heteromethod correlation, contrasting with the average monotrait-heteromethod correlation, i.e., the mean of all correlations of indicators measuring different constructs. An HTMT statistic below the threshold of (0.850), with none exceeding (0.845), indicates good discriminant validity.

Using a consistent PLS bootstrapping method, HTMT's confidence interval does not contain 0. Consequently, the discriminant validity is excellent. The model's construct validity is adequate, in my opinion. It is now time to evaluate the assumptions that have been posited using the outcomes of the developed structural model, which has proven its reliability and validity. Similar to typical beta values in regression analysis, PLS model path coefficients were used in the same way. Mooi and Sarstedt (2011) and Sarstedt et al. (2014) recommended that the model be verified for collinearity before estimating the coefficients of the paths using ordinary least square regression. Hair et al. (2014) asserted that collinearity in the results of these analyses could indicate bias. Therefore, this study followed Wong (2013) and Sarstedt et al. (2014) in determining if there is a correlation between the constructs. A multiple regression analysis using the latent variable scores as input was conducted to determine whether the internal model's

collinearity difficulties could be resolved by constructing independent variables from the external latent variables (namely, E.A., UMG, SUD, URL, and IPD). The dependent variable, on the other hand, was Hangwurian City Development.

Similar to typical beta values in regression analysis, PLS model path coefficients were used in the same way. Because path coefficients are computed using ordinary least square regression, it was previously suggested that collinearity should be investigated. Hair et al. (2014) asserted that collinearity in the results of these analyses could indicate bias. For this reason, we followed Wong (2013) and Sarstedt et al. (2014) and checked to see if the two constructs were linked. Exogenous latent variables URL, SUD, E.A., and UMG were constructed as independent variables using latent variable scores for multiple regression to examine collinearity issues in the inner model.

The dependent variable in this study was HCD, and a path link was created between many exogenous latent components and their corresponding influence on it. Environmental consciousness, inclusive physical development (IPD), sustainable city development, urban liveability, and the development of *Hangwurian* City are all linked, according to research (HCD). Both the E.A.-to-HCD and UMG-to-HCD pathways were examined.

The outlined hypothesised path of the development of *Hangwurian* City and its endogenous variables, shows that the indicator variables of the proposed model is supported. The implication of this is that access to the city as typified by access to different parts of the city, access to mortgage facilities, access to urban transportation, and access of women to all parts of the city is a critical consideration when analysing urban spatial development. Another aspect of the hypothesised path of the *Hangwurian* city development is the aspect of consumption pattern in the development of the city. These is typified by waste management and recycling techniques, work safety, participation in infrastructure provision amongst others are the critical path of the *Hangwurian* model path which must be prioritised in the development agenda of the city space.

5. CONCLUSION

The analysis of the model significance of the research shows that a substantial number of the indicator variables of the constructs tested showed clear significance and applicability in the study area. A major essence of the research model is to ensure that the outcome of the model validation complied with extant literature and existing knowledge pool. This was also clearly established as Urban liveability (URL), sustainable development (SUD), inclusive physical development (IPD), environmental awareness (E.A.), and urban governance (UMG) were assessed in this study.

All of the individual constructs in the Hangwurian Model had an internal consistency of at least 0.70. To ensure that a construct is genuinely unique from other constructs, convergent validity and Composite Reliability were used to evaluate it. It is therefore recommended that:

The individual constructs of the model which are sustainable urban development, environmental awareness, urban liveability, urban management and governance, and inclusive physical development must be prioritised in the process of evaluating urban development which will prioritise the residents in the areas under consideration.

The Fornell and Larcker criterion suggests appropriate discriminant validity in evaluating these methods' results. The Henseler, Ringle, and Sarstedt heterotrait-monotrait (HTMT) ratio was also utilized. Analogous to typical beta values in regression analysis, PLS model path coefficients were similarly employed. The results indicated that Environmental Awareness (E.A.), Urban Management and Governance (UMG), Urban Liveability (URL), and Sustainable Urban Development (SUD) positively and significantly impact Hangwurian City Development (HCD).

Given that discriminant validity demonstrates the influence of the Hangwurian model's subconstructs, it is recommended that: In analyzing urban development, the various issues constituting the indicators for E.A. (Motivation, Environmental Knowledge), such as the regulation and modification of the utilization of environmental resources, must be addressed. Urban governance and management should also be prioritized to ensure that residents are informed of the challenges posed by the indiscriminate exploitation of space and its consequent effects. Furthermore, regulations must be applied in modifying the environment to ensure liveability, sustainability, and inclusiveness so that residents are assured of safe and resilient urban spaces that enhance the quality of life while being resilient and providing access for every class of people within the urban space to thrive.

It is imperative to acknowledge that Access to the City (ATC), Consumption Pattern (CSP), and Equity are pivotal values, as established by the research, for maintaining an urban environment that ensures safety, economic prosperity, and proper place shaping—core ideals of the Hangwurian Model for urban development.

This research concludes that urban development, though a complex process involving multiple modifications and value additions to human spaces, must be strategically approached. This approach should ensure that actions within the urban space foster the growth and development of all its components without detriment. Moreover, for sustainable urban infrastructure and inclusive physical development, it is essential to adopt the Hangwurian perspective, which evaluates development through the triads of consumption, access, and equity.

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ASSESSING THE CHARACTERISTICS OF COASTAL NEIGHBOURHOODS THAT INFLUENCE FLOOD SUSCEPTIBILITY IN KOSOFE, NIGERIA

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ABSTRACT

As climate change continues to exacerbate weather patterns, flood susceptibility has become an increasingly pressing global concern. The susceptibility to floods is influenced by many contextual factors; as such, characterizing coastal neighbourhoods for the purpose of articulating susceptibility pathways is crucial for developing appropriate physical planning policies. The specific research objective seeks to assess the dimensions of neighbourhood characteristics that influence flood susceptibility in Kosofe, a suburban coastal community in Lagos, Nigeria. The data used were based on primary and secondary sources. Using a systematic sampling method, 324 respondents participated in the field survey. The result of the descriptive statistics, as reflected in the moderate (3.32) to low mean value (1.54) from the highest to the least ranked features, showed some level of inadequacies with the overall quality of the neighbourhood. Also, the outcome of the factor analysis identified two dimensions of neighbourhood characteristics in the study area: spatial configuration and amenities. Further analyses showed that the factors that significantly influence flood susceptibility within Kosofe are embedded within its spatial configuration. This implies that the layout of various physical attributes and features of coastal neighbourhoods has important implications for flood risk reduction. Considering features such as natural open spaces, flood gardens, drainage systems, waste management infrastructure, water supply, roads and street networks, flood barriers, and warning systems are vital in spatial planning to minimize flood susceptibility and enhance resilience in coastal neighbourhoods.

Keywords: Amenities; Coastal neighbourhoods; Flood Susceptibility; Spatial configuration

1. INTRODUCTION

Effective policies, plans, and strategies related to climate change adaptation and flood risk mitigation are based on community realities. Floodplain communities are particularly susceptible to severe impacts due to their socio-economic vulnerability, traditionally reflected in five forms of housing deprivations: limited access to water and sanitation, unstable rents, overcrowding, and precarious housing structures (Begoña et al., 2020). Many of these communities are in developing countries across Asia and Africa (Rentschler et al., 2022; Diarte et al., 2020). Studies have also linked increasing vulnerability to limited knowledge of flood-susceptible areas (UNEP, 2021). Within the context of flood vulnerability, susceptibility implies the degree to which a community, or a physical structure, is prone to damage or disruption from flood impacts (Kaoje et al., 2021). In other words, it refers to the inherent characteristics or qualities of the system that make it more or less vulnerable to flooding. The goal of flood susceptibility analysis is to identify flood risk zones based on their inherent characteristics, which are essential for developing effective mitigation strategies and emergency response plans (Swain et al., 2020; Sahraei et al., 2023).

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This effort aligns with the 2015 Paris Agreement to evolve preventative policies geared towards adapting to change, while minimizing negative impacts (Surminski et al., 2020). It thus implies that appropriate physical planning policies and strategies based on susceptibility analysis are required to protect high-risk populations (Yu et al., 2021; Chen et al., 2020).

In Lagos, Nigeria, population growth and continuous physical development expansion in many parts of the coastal city are exacerbating flood damages and losses (Atufu & Holt, 2018; Ajijola et al., 2020). For example, it is well documented in the literature that Kosofe, a coastal community within Lagos city, suffers incessantly from unmitigated flooding, thus exposing the vulnerable population to severe flood impacts (Lucas, 2021; Awodumi, 2020; Oyinloye et al., 2013). This situation is attributed to high population density and limited availability of land for expansion, as building development continues to sprawl into high-risk zones, thereby increasing exposure to flood risk, whose intensity is more severe during the rainy season (Adelekan, 2016). The most severe impacts are related to property damages, disruption of business and essential services, physical illness, psychological stress, and flood-related water and safety issues (Ouikotan, B et al., 2017; Oyinloye et al., 2013). Similarly, lack of medical care after flood damages, poisoning from ruptured pipes, storage tanks, and soil contamination can escalate the negative impacts of large floods (Nkwunonwo et al., 2016; Adelekan, 2016). The combined economic and physical impacts of floods highlight the significance of mitigation efforts.

Most of the existing related studies (Adelekan & Asiyanbola, 2014; Adelekan & Alaba, 2016; Ologunorisa & Yisa, 2016; Adedeji & Adelekan, 2017; Ene & Balogun, 2018) utilize various techniques such as GIS (Geographic Information System), remote sensing, and machine learning to assess flood susceptibility in different regions of Nigeria. However, very limited studies exist on the assessment of susceptibility pathways in Kosofe. The Lagos State Government (LASG) has initiated the process of developing a Kosofe Sub-Region Master plan, which is envisioned to be a comprehensive development policy for the Sub-region over the next 20 years, focusing on a sustainable inclusive environment. This was deemed necessary in view of the rapid development in Kosofe and the imperatives of ensuring orderliness in the Sub-region. This presents a prospect to improve the resilience of the region through community-centered design strategies and processes, as part of a global system of addressing flood susceptibilities. Therefore, this study is carried out to assess specific neighbourhood characteristics that influence flood susceptibility in Kosofe, with a view to suggesting appropriate mitigation strategies. The study is significant as it attempts to provide guidance for architects and urban designers tasked with improving the quality of the built environment of coastal neighbourhoods.

2. LITERATURE STUDY

2.1 Neighbourhood Context in Flood Risk Management

The concept of a neighbourhood is used to explain the various attributes and features that define a particular area or community within a larger urban or suburban context (Meenakshi, 2011). It implies the subdivisions of a city, village, or town, characterized by specific physical or psychosocial features that make them different from the rest of the settlements. On one hand, the physical features may include the type of buildings, housing density, infrastructure quality, land use patterns, and availability of amenities such as parks, schools, and shopping centers within walking distance for most residents (Aydin & SiraBüyük, 2014). On the other hand, the psychosocial characteristic describes the social relationships among residents (Yen & Michael, 2012). In addition, social and demographic factors like population diversity, income levels, crime rates, and community engagement also contribute to neighbourhood characteristics (Azad & Pritchard, 2023).

Neighbourhood characteristics play a crucial role in influencing the quality of life, social interactions, and overall well-being of residents (McCormack, 2017). They can impact factors such as safety, livability, access to essential services, property values, and opportunities for social and economic mobility. Therefore, neighbourhoods should be designed with the capacity to reduce the vulnerability of residents to environmental risks and stresses (Vale, Shamsuddin, Gray, & Bertumen, 2014), especially those that may be caused by the impact of increasing flood risk. Before considering the capacity of the neighbourhood to absorb stress, it is first essential to examine the drivers for neighbourhood development. Studies reveal that a majority of urban migrants that form the rapidly growing urban neighbourhood in coastal cities are of the low-income category with limited adaptive capacities (Rentschler et al., 2022; Jones, 2015); therefore, such patterns and trends of development impact flood susceptibility in different ways.

Table 1 Summary of Physical Neighbourhood Features in Flood Susceptibility Analysis

Criteria	Characteristics	Authors
Spatial patterns	Distance to water bodies, proximity to main roads	Kaoje et al, 2021
	Residential buildings, Traffic roads, Activity sites and landscaping	Wang et al, 2019
	Slope, distance from drainage network (DFDN), Land use & land cover (LULC), and altitude/elevation	Mahmoud & Gan 2018
Infrastructure	Recreation, information and communication, Public utilities, networks, and early warning systems	UNEP, 2021 Wang et al., 2019
	Sustainable Urban Drainage Systems (SUDs) such as green areas, permeable paving, retention ponds/gardens, flood barrier	Galderisi & Terccozzi, 207 Lennon et al, 2014

Hence, the greatest environmental demand of rapid population growth would be land for development (Chen, et al., 2020). With the availability of land being limited in supply, physical development may be inelastic; this implies that its finite nature makes it a scarce resource that cannot meet its demand. Consequently, natural land use has been converted to urban areas and other functions (Idowu & Zhou, 2021). This has been described as pervasive, even though the need is essential (Oduwaye, 2009). It is documented in the literature that between 1990 and 2000, forested wetlands reduced by over 70% with an exponential growth in the built-up area in Lagos, Nigeria (Ajijola et al., 2021). A critical environmental consequence of change in land use includes the rapid loss of green belts and wetlands, which have been attributed to causing a rising flood risk (UNEP, 2021; Ahmed et al., 2022). Therefore, effective spatial planning of neighbourhoods is required for successful mitigation of the growing flood risk.

Furthermore, the provision of infrastructure and public amenities to support residents increases in direct proportion with population growth (UNEP, 2021). Such infrastructure would include space for socio-cultural activities, education, shopping facilities, power supply, health centers, pedestrian walkways, access roads, sewage and waste disposal, water services, stormwater drainage systems, gas distribution (where applicable), and so on (Meenakshi, 2011; Aydin & SiraBüyük, 2014). It is a general idea that infrastructural developments come with increased surface sealing (Lu et al., 2018). Urban areas with a high percentage of impervious surfaces are more prone to flooding due to the reduced ability of the land to absorb water (Chen, et al., 2020). Therefore, in coastal cities, there would be concern for adequate future services, appropriate flood

protection measures, floodwalls, retention ponds, natural recreational areas, early warning systems, and the construction of flood-resilient homes when considering risk-informed neighbourhood planning (Kometa et al., 2021; Wang et al., 2019). Thus, the spatial pattern and neighbourhood infrastructure are important considerations in analyzing a community's susceptibility to flood risk. Therefore, understanding and considering these characteristics is important in reducing the susceptibility of risk neighbourhoods and exposed populations.

3. METHODS

3.1 Study Context

Figure 1 Map of Lagos, showing Kosofe
(source: Ajijola et al,. 2020)

Table 2 Main Zones and Flood Vulnerability Data in Local Areas of Lagos

Zones	Local Government	Land Area (KM)	Risk Area (KM)	Flood Risk %
Zone A	Apapa	42	28	67
	Eti-Osa	182	51	28
	Ikeja	46	0	0.002
	Lagos-Island	241	236	98
Zone B	Agege	16	0	0
	Alimosho	149	11.8	7.9
	Amuwo Odofin	175	73.5	42
	Ibeju/Lekki	464	51	11
	Ifako/Ijaye	33	0	0
	Kosofe	**74**	**36**	**49**
	Mainland	22	3.7	17
	Mushin	17	0.7	4
	Ojo	181	39	22
	Oshodi/Isolo	38	0.7	2
	Shomolu	18	2.5	1
	Surulere	30	5	17
Zone C	Ajeromi/Ifelodun	11	3.3	30
	Badagary	498	139	28
	Epe	1212	441	36.4
	Ikorodu	372	22	6
TOTAL	**20**	**3,833**	**1,144**	**29.8**

Source: Kaoje & Ishiaku, 2017; Otic Survey, 2018

The study area is Nigeria (See Figure 1), the most populated urban area in Africa with a population density of 3418.85 sq.km (Knoema, 2023). There are 20 local government areas (LGAs) in Lagos, spread across three main zones: Zone A, Zone B, and Zone C (see Table 2) (LG, 2016). Within Zone B, which covers the majority of LGAs in the city, Kosofe has the highest percentage of flood risk zones. Notably, the area continues to experience recurrent flooding scenarios, thus increasing the vulnerability of households to severe impacts. Therefore, the study area is delimited to residential neighbourhoods in Kosofe, Lagos.

3.2 Research Design

The study into neighbourhood characteristics for assessing flood susceptibility is based on both secondary and primary data sources. Using a deductive approach, a list of 14 variables (*natural features/recreational areas, health center, schools, drainage systems, waste disposal facilities, water supply, power supply, access roads and streets networks, space for social & religious activities, shopping, permeable walkways, floodwalls/barriers, retention ponds/gardens, and flood warning systems)* were identified to be relevant in assessing neighbourhood characteristics of the study area. These characteristics were subjected to a cross-sectional survey involving residents/household representatives in Kosofe. A total of 2309 households were identified. Using the systematic random sampling technique with a sampling interval of 6, calculated by dividing the population size of 2,309 households by the initial sample size (341 units) derived from Yamane's formula (1967); ($n = \frac{N}{(1+Ne^2)}$). The effective sample size was further obtained by dividing the total households by the sampling interval. This resulted in 385 households. The questionnaire was administered to each household via a representative. The well-structured closed-ended questionnaire, which contained a 5-point Likert-type scale, was administered physically through a field assistant. The feedback from the survey was analyzed for frequency, percentages, and exploratory factor analysis. A Cronbach Alpha reliability test was carried out to determine the consistency of the variables. An acceptable value of 0.975 was obtained.

4. RESULTS AND DISCUSSION

4.1 Basic Information of Respondents

Out of the 385 questionnaires distributed, 324 respondents completed the questionnaire, which represents a high 84.15% response rate.

Table 3 Respondent's Basic Characteristics

		Freq.	(%)
Gender	Female	122	38
	Male	202	62
Age Distribution	18 – 30	87	27
	31 – 43	95	29
	44 – 56	62	19
	57 – 65	41	13
	66 - above	39	12
Level of Education	Basic	54	17
	Secondary	69	21
	Tertiary	201	62

Source: Researcher's Result, 2023

The basic information of respondents is presented below (see Table 3). Analysis of the gender distribution shows that the majority (62.3%) are male, while 37.7% are female. Also, the highest age distributions of respondents are 18-30 years and 31-43 years respectively, which accounted for a cumulative 56.2%. Similarly, 62% of the respondents have received a higher education. Furthermore, the majority (67%) of the households are long-staying residents of more than 11 years.

4.2 Neighbourhood Characteristics

The analysis of the neighbourhood characteristics, as presented in Table 4, reveals a generally moderate to low mean value. The feature with the highest mean value, indicating its availability, is space for social and religious activities, with a mean of 3.32. This is followed by the availability of educational facilities with a mean of 3.27, and shopping facilities with a mean of 3.19.

Table 4 Neighbourhood Characteristics in the Study Area

Available Neighbourhood Characteristics	Mean	Std. Deviation	Ranking
Social and religious activities	3.32	1.343	1
Educational facilities	3.27	1.609	2
Shopping Facilities	3.19	1.360	3
Power Supply	3.05	1.276	4
Health Center	3.02	1.531	5
Permeable Walkways	2.77	1.530	6
Good Roads and Streets Networks	2.59	1.308	7
Floodwall/ Barrier Along the River Channel	2.31	.850	8
Flood Retention Ponds/ Gardens	2.22	.737	9
Flood Warning Systems	2.17	.682	10
Domestic Waste Disposal Facilities	1.67	1.073	11
Adequate Stormwater Drainage Facility	1.60	.937	12
Natural features/ recreational Areas	1.54	.915	13
Portable water Supply	1.54	.792	13

The analysis of the neighbourhood characteristics reveals that the three least ranked features are adequate stormwater drainage facilities (with a mean of 1.60), natural features/recreational areas (with a mean of 1.54), and potable water supply (also with a mean of 1.54). This finding suggests that spaces for social and religious activities are the most available neighbourhood characteristic in the study areas, while the least available are potable water supply and natural recreational areas.

Dimensions of the Neighbourhood Characteristics in the Study area

To further determine the dimensions of neighbourhood characteristics influencing flood susceptibility, the 14 variables identified in the literature were subjected to factor analysis. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's Test of Sphericity were used to confirm the appropriateness of the data prior to the factor analysis. The KMO value was 0.925, indicating that the sample was adequate for factor analysis. Bartlett's Test of Sphericity was significant ($p = 0.000$), indicating that the variables were correlated enough for factor analysis (Kaiser & Meyer, 1974; Bartlett, 1954).

Table 5 KMO and Bartlett's Test

KMO Measure of Sampling Adequacy		.925
Bartlett's Test of Sphericity	Approx. Chi-Square	10194.281
	df	91
	Sig.	.000

Two main dimensions (components) were extracted using the extraction method involving Principal Component Analysis (PCA) and a Varimax with Kaiser Normalization rotation technique; as shown in Table 6 below.

Table 6 Total Variance Explained

Compo-nent	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Var.	Cumu lative %	Total	% of Var.	Cumu lative %	Total	% of Var.	Cumul ative %
1	11.286	80.616	80.616	11.286	80.616	80.616	7.222	51.589	51.589
2	1.394	9.954	90.571	1.394	9.954	90.571	5.457	38.982	90.571
3	.508	3.626	94.197						
4	.276	1.970	96.167						
5	.152	1.085	97.251						
6	.084	.597	97.848						
7	.068	.486	98.334						
8	.053	.379	98.713						
9	.045	.321	99.034						
10	.043	.310	99.344						
11	.033	.236	99.580						
12	.023	.161	99.741						
13	.020	.140	99.881						
14	.017	.119	100.000						

Furthermore, Table 7 provides a breakdown of the characteristics of the two identified dimensions (components). The analysis of the results reveals that the principal dimension *includes the availability of natural features/recreational areas, adequate stormwater drainage facilities, adequate domestic waste disposal facilities, adequate water supply, good roads and street networks, floodwalls/barriers along the river channel, flood retention ponds/gardens, and flood warning systems.*

Table 7 Presentation of Result of Factor Analysis

Dimension of the Neighbourhood Characteristics of the Study Areas	Factor Loadings	Eigen Value	% of Variance	Cum %
Dimension 1: Spatial pattern		**7.222**	**51.589**	**51.589**
Natural features/ recreational areas	.936			
Storm water drainage facility	.921			
Domestic waste disposal facilities	.914			
Water supply	.904			
Good roads and streets networks	.741			
Floodwall/ barrier along the river channel	.836			
Flood retention ponds/ gardens	.771			
Flood warning systems	.745			
Dimension 2: Amenities to Support Residents		**5.457**	**38.982**	**90.571**
Health care facility	.654			
Educational facilities	.949			
Power supply	.780			
Space for social and religious activities	.875			
Shopping facilities	.879			
Permeable walkways	.720			

This dimension accounts for 52% of the variance and has 8 of the 14 variables loaded on it. Hence, this dimension provides a clear picture of the main neighbourhood characteristics in the study area. The subsequent dimension accounts for around 39% of the variance and has 6 variables loaded on it: *health care facilities, educational facilities, power supply, spaces for social and religious activities, shopping facilities, and pedestrian walkways.*

4.3 Implications of Exixting Neighbourhood Characteristics on Flood Susceptibility

The analysis of the existing neighbourhood characteristics generally shows a moderate (3.32) to low mean score (1.54) from the highest to the least ranked features. This finding typically indicates that the overall quality of the neighbourhood falls somewhere within the middle to low range, thus implying that the neighbourhood has some features that contribute to its flood vulnerability. This deduction places an emphasis on the need for proactive interventions to enhance resilience and reduce the potential impact of flooding on the community. Although the highest-ranked neighbourhood features: amenities for social and religious activities, educational facilities, shopping facilities, power supply, and primary health centres could potentially be relevant to improving the quality of life, social interactions, and overall well-being of residents as indicated in the literature (Aydin & SiraBüyük, 2014). Significant inadequacies, as reflected in the very low mean score for domestic waste disposal facilities, stormwater drainage facility, potable water supply, and natural recreational areas in the neighbourhood, may have substantially contributed to increasing flood susceptibility in the study area.

As highlighted in previous studies, improper disposal of solid waste, such as plastic bags and other non-biodegradable materials, often block stormwater drains, impeding the flow of water during heavy rainfall and leading to localized flooding (Adelekan, 2016). Similarly, issues regarding insufficient drainage capacity may result in water accumulation on roads and low-lying areas, exacerbating flood risks; while poorly maintained drainage systems with blocked or collapsed pipes reduce the system's efficiency, leading to waterlogging and increased flood susceptibility (Lucas, 2021). In addition, the loss of green zones due to urbanization and the conversion of natural areas into impervious surfaces result in increased surface runoff, as water cannot infiltrate the soil. This excess runoff contributes to flash flooding (Atufu & Holt, 2018). Also, natural recreational areas, such as parks and wetlands, help absorb excess rainwater, thereby reducing flood risks. Their absence or degradation eliminates this natural flood mitigation mechanism. According to Rahman, Azad & Rahman (2023), insufficient potable water infrastructure in flood-prone neighbourhoods can exacerbate the challenges faced during and after flooding. Floodwaters can contaminate local water sources, rendering them unsafe for consumption, leading to waterborne diseases. Also, inadequate potable water infrastructure can hinder access to clean water for drinking, sanitation, and hygiene purposes, further compromising public health (Ajijola et al., 2023).

Table 8 Summary of Dimensions of Neighbourhood Characteristics Evaluation

Dimension of the Neighbourhood Characteristics of the Study Areas	Performance dimension of Resilient urban Communities by Case Studies
Dimension 1	**Spatial configuration of the neighbourhood**
Natural recreational areas, stormwater drainage facility, domestic waste disposal facilities, water supply, roads and streets networks, floodwall/barrier, flood retention ponds/gardens, flood warning systems	
Dimension 2	**Amenities to support neighborhood residents**
Heakth care facility, educational facilities, adequate power supply, space for social and religious activities, shopping facilities, pedestrian walkways.	

It thus implies that the lack of these critical features in flood-prone neighborhoods have specific implications for planning and implementing disaster risk reduction measures. As displayed in Table 8, two main dimensions which explain the characteristics of the study areas were identified.

The first dimension, with the greater factor loading, mainly represents the attributes of the spatial configuration of the neighbourhood, while the second dimension includes amenities to support residents of the study area. Thus, indicators in the spatial configuration of the neighbourhood are more influential in assessing the degree of flood susceptibility and therefore should be given consideration when planning for flood mitigation in coastal communities. This finding seems to be consistent with previous studies (Wang et al., 2019; Oduwaye, 2009), proposing that the spatial pattern of an urban community is key to building its resilience and community structure in a changing environment.

5. CONCLUSION AND RECOMMENDATION

The specific objective of this study was to assess the dimensions of neighbourhood characteristics that influence susceptibility to flood risk in Kosofe, Lagos, Nigeria. The result of the factor analysis revealed two dimensions: (i) the spatial configuration, and (ii) amenities to support residents of the study area. The findings further showed that critical neighbourhood characteristics that significantly influence susceptibility to flood hazards are embedded within the spatial configuration. Therefore, developing planning policies to improve the spatial patterns of the coastal neighbourhood is imperative. Understanding and considering factors such as natural features (elevation, topography, and coastal geomorphology), natural open spaces, infrastructure design (water supply networks, waste management and drainage systems), setback zones, buffer areas, and evacuation routes are vital in spatial planning to minimize flood susceptibility and enhance resilience in coastal neighbourhoods. It is thus recommended that, first, new and existing land use policies should discourage development in high-risk flood areas. Second, there is a need to identify and protect open spaces, wetlands, and natural drainage areas to allow for natural water absorption and floodwater retention, thus reducing the risk of flooding. Third, incorporating flood-resilient design principles into the neighbourhood's spatial layout, such as elevating roads and walkways, creating flood-safe routes, and integrating green infrastructure elements like rain gardens and ponds, is crucial. A comprehensive and collaborative approach to planning and implementing these measures is crucial for effective disaster risk reduction in coastal neighbourhoods.

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LAND SURFACE TEMPERATURE AND LANDUSE/LAND COVER CHANGE VARIABILITY REMOTELY SENSED DATA FOR SUB-URBAN SETTLEMENTS IN OSUN STATE, NIGERIA

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ABSTRACT

Land surface temperature (LST) is an indispensable factor in studying urban climate. Ground-based measurements have been employed to quantify LST and Land Use/Land Cover Change (LULC). However, due to advancements in space technology and extensive spatial coverage, remote sensing techniques are increasingly being used to measure the intensity of LST and LULC dynamics, owing to the availability of enhanced satellite-based thermal observations of the Earth. The climatic conditions over a medium-sized city could be improved by understanding the interplay of LST and LULC. In this study, we estimated LST based on Landsat bands 4 and 5 for 1990 and 2000, band 6 for 2010, and band 10 for 2021 to reveal the interplay between the characteristics of land use and land cover and LST over Inisa and adjoining settlements. The study revealed that the maximum and minimum LST from 1990 to 2021 was 30.2°C for built-up areas and 21.1°C for farmland, respectively. Built-up areas increased from 2.5% in 1990 to 15.43% in 2021. Remotely sensed data can reveal the variability of LST and LULC to assess the climatic phenomenon. They can inform future planning to secure green and livable urban areas in this era of a changing climate.

Keywords: Medium-sized city; Remote sensing; Climate change; Temperature variability; Landuse/Land cover Change

1. INTRODUCTION

Land surface temperature (LST) can also be described as the radiative skin temperature of the land, determined by solar radiation and obtainable remotely via satellite or aerial remote sensing (Yang et al., 2017). It is a critical parameter of the Earth's surface systems that regulates energy flow on the surface at both micro and macro scales (Mao et al., 2021). The quantity of thermal radiation emitted from the land surface, measured by LST, occurs during the interaction of solar rays with the existing heat in the Earth's atmosphere or the surface of the canopy in primary forest regions of rainforests (Dash et al., 2002). LST is integral to all aspects of geoscience. Its understanding is fundamental for many analyses, including soil moisture estimation (Chuvieco et al., 2019), wildfire monitoring (Shivers et al., 2019), mitigation of urban climate change (Peng et al., 2020), and estimation of urban heat islands (Addas et al., 2020). Other applications include the surface energy budget (Li et al., 2013), land surface processes (Norouzi et al., 2015), and the retrieval of various atmospheric variables (Susskind et al., 2019).

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High spatial resolution time-series temperature data obtained from satellites provide essential knowledge that can be utilized to understand the dynamics of the land-atmosphere interface in diverse environments. LST at different scales has become feasible thanks to the development of thermal infrared (TIR) sensors (Mao et al., 2021). A thermal infrared band is measured by the Thematic Mapper TM on Landsat 4/5 and the Enhanced Thematic Mapper Plus (ETM+) on Landsat 7. At the same time, the Thermal Infrared Sensor (TIRS) on Landsat 8 captures land surface temperature in two thermal bands. The Moderate Resolution Imaging Spectroradiometer (MODIS) aboard the Terra and Aqua satellites gathers three thermal bands at a 1 km resolution twice daily. In comparison, the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) aboard the Terra satellite collects five thermal infrared bands at a 90m interval every 16 days. The European Space Agency's Along-Track Scanning Radiometer (ATSR), Advanced Along-Track Scanning Radiometer (AATSR), and Sea and Land Surface Temperature Radiometer (SLSTR) offer thermal images with a spatial resolution of 1 km twice a day. The National Meteorological Satellite Center of China's Visible and Infrared Radiometer (VIRR) Fengyun-3 (B/C) and the Infrared Multispectral Scanner (IRMSS) onboard HJ-1B offer thermal images at varying temporal and spatial resolutions of 1 km, 300 m, and 40 m. Additionally, geostationary satellites such as Fengyun-4A, MSG (Meteosat Second Generation), and GOES (Geostationary Operational Environmental Satellite) can provide numerous thermal images of the same area of the planet at intervals of up to 15 minutes (Mao et al., 2021).

Turco et al. (2015) assert that significant variations in precipitation and surface air temperature extremes have been reported at global and regional levels using observations and climate models since the second half of the twentieth century. A significant reduction in vegetation within central and northeast India and soaring cropland areas in western India was observed between 1985 and 2005 using 10-year satellite-derived data of land use/land cover (Roy et al., 2015). Li et al. (2016) also reported a considerable increase in mean sea level (~0.28 K decade-1) from 2003 to 2013 as a result of deforestation in tropical areas. Wei et al. (2017) reported the highest near-surface warming over desert regions, owing to the combined effect of warming and moistening of the troposphere. Mildrexler et al., (2018) discovered large-scale directional shifts in the global maximum LST resulting from a change in the surface energy balance using daytime LST Collection 5 data from the Aqua MODIS sensor for 2003-2014, while Zhao et al., (2019) utilized LST outputs from the MODIS sensors to evaluate the trends in the central Himalayan region's mean annual LST and annual maximum LST, finding that these two parameters are rising more quickly during the day than at night.

A major issue contributing to regional and global climate change is land surface temperature (LST) variation. In less developed countries, where temperature stations are inadequate, monitoring and reporting LST's daily or monthly distribution has become a challenge. This makes it difficult to prevent the perversion of drought, skin and lung problems, and the dwindling of crop production, aggravating food security issues in developing countries. Extracting LST from satellite imagery without land-based meteorological stations has been a relieving alternative. A thorough evaluation of the regional heterogeneity in LST is essential for socioeconomic gains. Therefore, this study comprehensively assesses the variations in LST between 1990 and 2021 in the neighboring environment of Inisa (a medium-sized city) in Osun State, Nigeria, using Landsat bands 4, 5, 6, and 10.

2. LITERATURE REVIEW

In the early 19th century, Howard et al. (1833) noted variations in land surface temperatures (LSTs) between suburban and urban locations. Thermal-infrared remote sensing technology, which can identify the thermal radiation released by ground objects, has emerged as a useful tool for studying LSTs (Zhi et al., 2020). The limited coverage by meteorological stations has been mitigated by the advancement from meteorological station observation data to multisource data analysis for measuring surface temperature changes. Numerous retrieval techniques have been proposed for various sensors. These algorithms can be divided into single-channel, split-window, and multi-channel categories, based on the number of required channels (Wang et al., 2019).

A large spatiotemporal dataset of LST and environmental parameters, including terrain, snow, vegetation, and insolation, is needed to create accurate models that depict the spatiotemporal interactions between LST and these factors. Remote sensing data is highly beneficial in this context because it is repetitive and synoptic, enabling the integration of existing topographical data with temporal and geographical data about vegetation cover, snow cover, and LST. Consequently, remote sensing data can provide a dataset that simulates spatiotemporal relationships among vegetation, snow cover, and LST in any physical terrain (Van De Kerchove et al., 2011).

Previous reports (Coppin et al., 2004; Eastman and Fulk, 1993; Jönsson and Eklundh, 2004) have described and quantified the temporal properties of remote sensing time series using a variety of methodologies. Various researchers have effectively minimized noise and enhanced relevant temporal aspects using the fast Fourier transform (FFT) among other methods (Azzali and Menenti, 2000; Evans and Geerken, 2006; Jakubauskas et al., 2001; Menenti et al., 1993; Olsson and Eklundh, 1994). The FFT breaks down time series into frequency domain periodic signals, allowing for examining signals at a particular frequency. Furthermore, when applied to a multi-year time series, the FFT preserves only the general recurrent signals by selecting those pertinent harmonics. Consequently, the FFT is a suitable technique to compare climate-related temperature signals to datasets of explanatory variables.

Additionally, research has been conducted on LST trends that are daytime, nighttime, seasonal, and annual (Yang et al., 2017); the impact of urban morphology, both two-dimensional (2D) and three-dimensional (3D), on LST (Cao et al., 2021); the effects of architectural forms and spaces on LST (Huang and Wang, 2019); changes in LST along urban and rural gradients (Estoque et al., 2017); the causes of land surface temperature (LST); the effects of urban heat island (UHI) on vegetation phenology and urban air circulation (Zhou et al., 2016); and the use of models like the Urban Canopy Model and Weather Research and Forecasting (WRF) Model to simulate urban thermal environments (UCM) (He et al., 2019).

3. METHODS

Inisa is a town in Osun State, southwestern Nigeria (Figure 1). It serves as the headquarters of the Odo-Otin South Local Government Development Area and has access to the southwest railroad, approximately 135 miles (215 km) from Lagos. Located on the road leading from Ikirun to Offa and Ilorin, as shown in Figures 1 and 2, Inisa acts as a small marketplace for a savanna region primarily inhabited by Yoruba people, selling goods such as yams, cassava (manioc), corn (maize), pumpkins, beans, and okra. The town is a trading center for cocoa and other agricultural products grown in the surrounding areas and serves as a collecting point for cash crops like cotton and tobacco. Inisa boasts several public and private educational and health institutions. The population of the town was 180,553 in 2007, projected to reach 289,601 in 2021.

Inisa environs has a tropical wet climate as it falls within the tropical rain forest zone. The wet season starts from around March to October, while the dry season, which is characterised by harmattan, starts from around November to February. The town enjoys a fairly high uniform temperature, with average day temperature of about 38.70C and an average night temperature of about 25.50C as at February 2022, (Table 1).

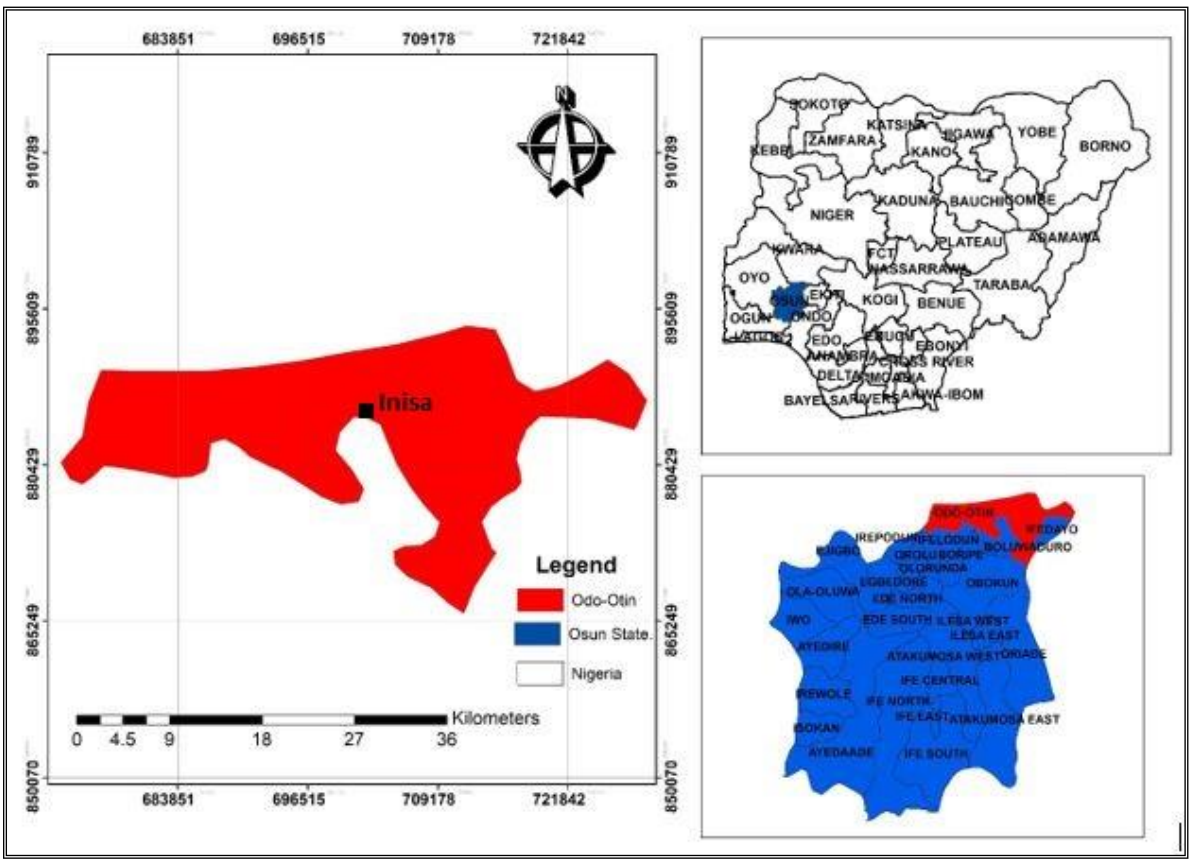

Figure 1 Inisa Town in Odo-Otin South Local Government Development Area, Osun State Nigeria

Table 1 Climate Features of Inisa

Month	Day (ºC)	Night (ºC)	Rain Days	Rainfall (mm)	Humidity (%)
January	37	23	13	37.43	55
February	37	25	20	94.93	64
March	35	25	28	173.17	72
April	34	25	28	209.87	76
May	33	24	30	296.46	82
June	30	23	30	390.67	88
July	29	23	30	420.81	89
August	29	22	30	417.86	88
September	29	23	30	480.57	89
October	31	23	31	418.58	87
November	34	24	25	141.58	78
Desember	36	24	10	24.10	58

Source: https://weatherspark.com/y/50070

Remote sensing techniques were utilized for land surface temperature (LST) estimation and surface emissivity estimation. The spatial resolution of the thermal band (Landsat bands 4 and 5 for 1990 and 2000, band 6 for 2010, and band 10 for 2021) was employed to estimate the LST in Inisa Town with a 30-meter spatial resolution. A model builder was used to generate LST within the ArcGIS 10.8 environment. This process involved clipping the image, converting the digital number (DN) to top-of-atmosphere (TOA) radiance, estimating LST, deriving vegetation indices, and compiling maps. The surface temperature for 1990, 2000, 2010, and 2021 was calculated using the emissivity-adjusted land surface temperature method, which requires the input of emissivity values from various surfaces (Figure 2).

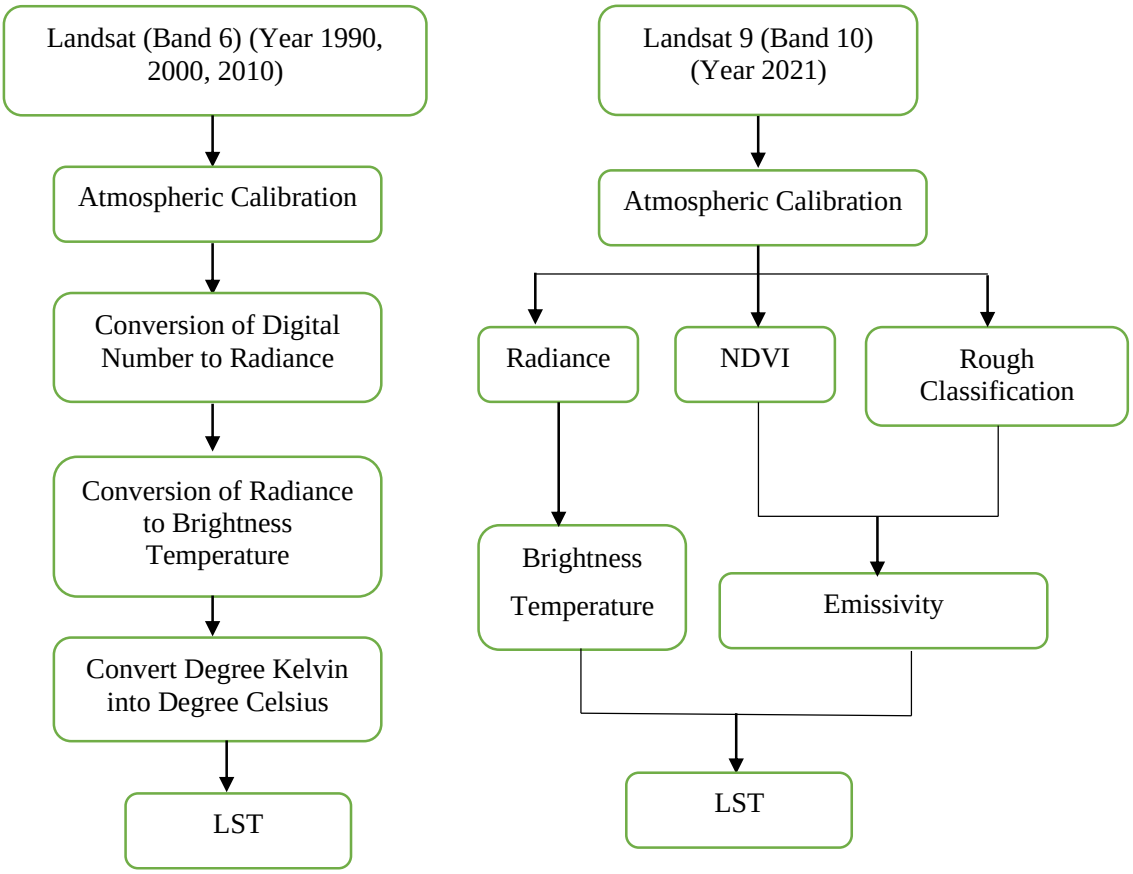

Figure 2 Image Processing Procedures

3.1 Land Use/Land Cover

Landuse/landcover was analysed by analysing spot imagery with similar spatio-temporal span and less than 10% cloud coverage, also for the prediction. Data from the same sensors were chosen: Spot 1990, Spot 2000, Spot 2010 and Spot 2020. The applied images obtained from Worldwide Reference System within the path 055/ row 190 is illustrated in Figure 3.

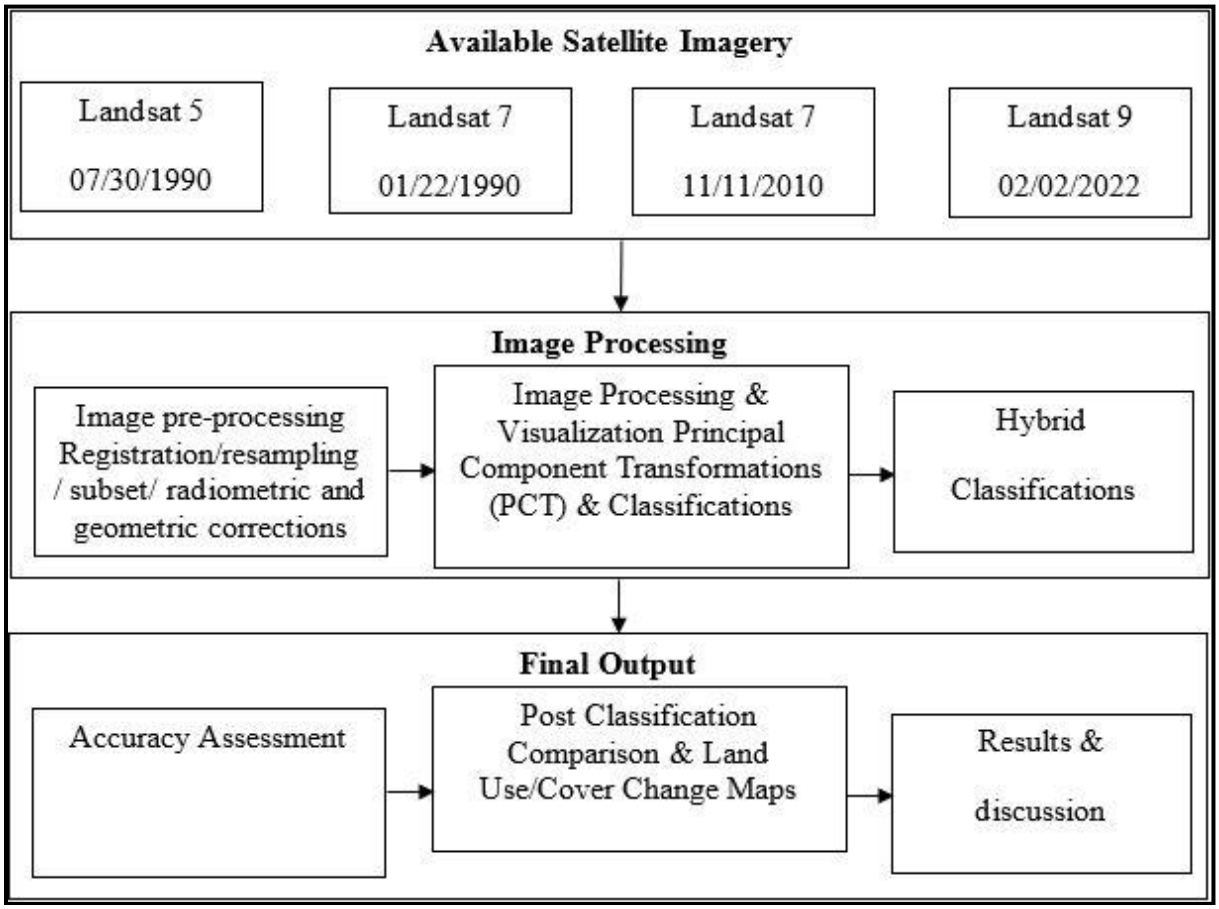

Figure 3 Image Acquisition and Processing

A GPS receiver Garmin 76 and Mobile GPS Enable device with ODK Collect Form was employed to collect primary data in Inisa. During the field survey conducted from August 4 to August 7, 2021, a total of 741 geographic coordinates were obtained. Obtaining ground points between 30 to 50 for each category of landcover would be a wise general rule of thumb (Congalton and Green, 1999). The ground truth data that were gathered in the field were split at random and used for accuracy evaluation and training.

3.2 Image Processing

As shown in Figure 4, the TerrSet model and the modified dark object subtraction (DOS) atmospheric correction, which utilizes the cosine of the sun zenith angle (COST) correction, were used to convert the digital numbers (DNs) of each image to surface reflectance. Inputs into the model include the Earth-Sun Distance, solar elevation, and the lowest DN values for each band. The three bands—2, 3, and 4—that were imported into the TerrSet model environment underwent preprocessing before being subjected to a composite operation.

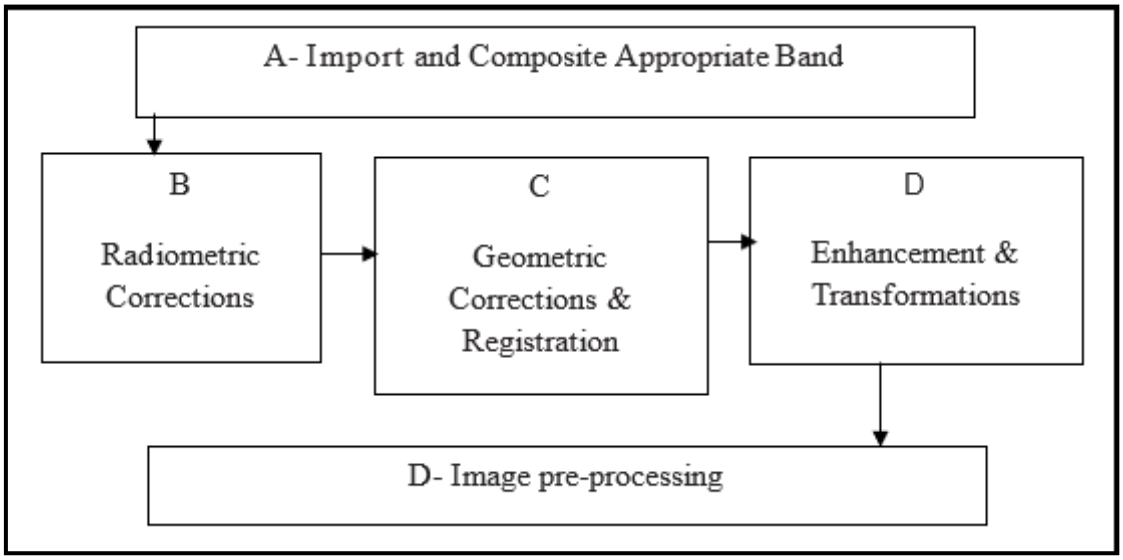

Figure 4 Preprocessing Workflow

3.3 Image Classification

The Maximum Likelihood Classifier was selected for Land Use/Land Cover (LULC) classification in the Inisa area. A classification scheme was developed, from which five information classes were derived: 1) Bare land; 2) Built-up; 3) Dense Vegetation; 4) Farmland; 5) Water Bodies. The three-band images were modified by Principal Component Analysis (PCA) and the Normalized Difference Vegetation Index (NDVI). Subsequently, the images were merged and categorized using the Maximum Likelihood Classification method. Ultimately, the images from various periods were contrasted to identify and detect changes in land cover and use. The extent of change in each land use/land cover category was determined using overlay and cross-tabulation techniques. The classification accuracy will be evaluated using the Kappa Index of Agreement (KIA) (Figure 5).

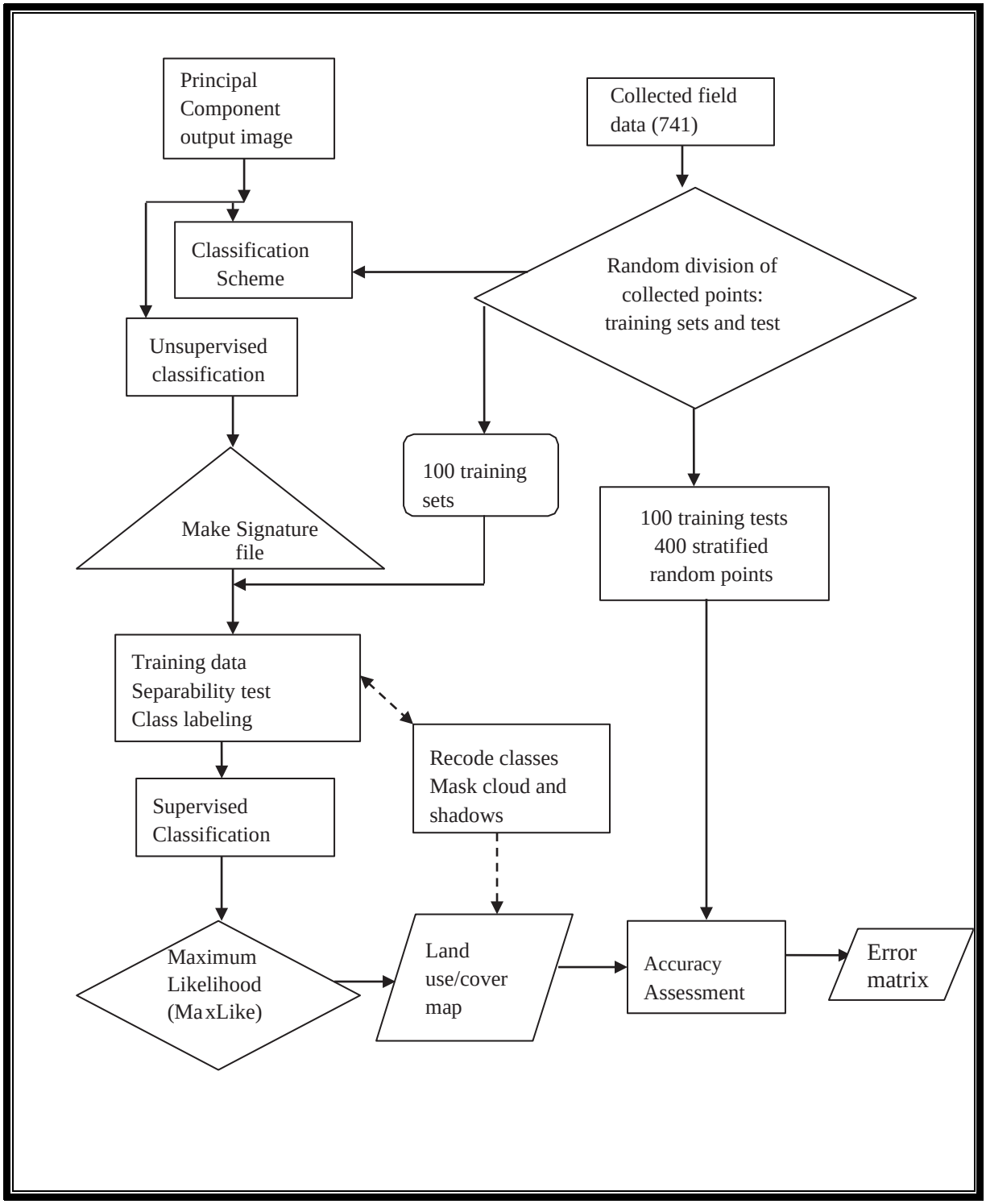

Figure 5 Flow Diagram for Classifying Images and Evaluating their Accuracy

4. RESULTS AND DISCUSSION

4.1. Results and Discussion

The spatial analysis revealed that the maximum land surface temperature (LST) from 1990 to 2021 was 30.2°C and minimum was 21.1°C. The maximum in 1990 was 35 °C, while the minimum was 24.9°C. In 2000, 38.7 °C was the highest and 20.2°C was the minimum. About

23.9 °C was the least recorded in 2010, while 37.3°C was the peak. In 2021, the LST reached the zenith at 40.5°C, while the least recorded was 23.9°C (Figs 6, 7, and 8).

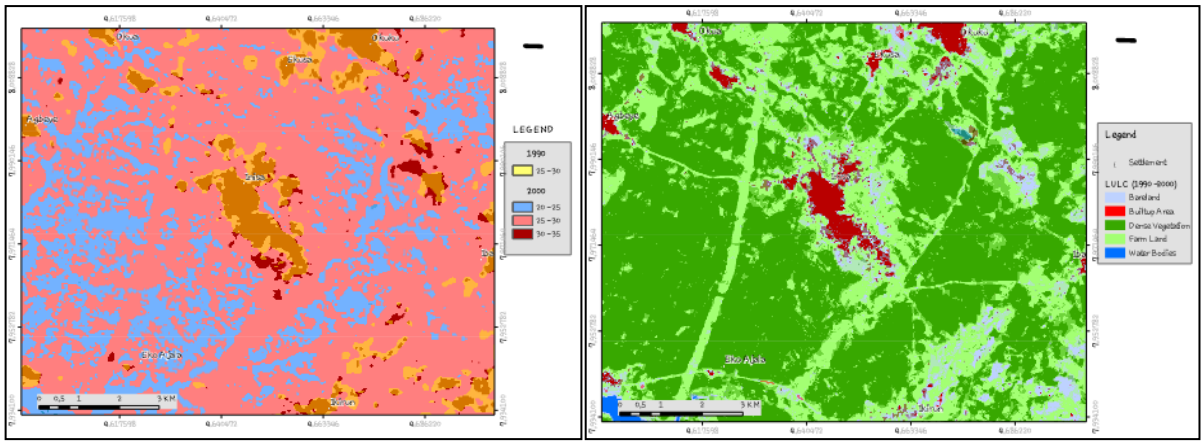

Figure 6 Mean Characteristics of LST across Inisa, 1990-2000 and Landuse/Land Cover Type for Inisa Environs 1990-2000
(source: Processed from Satellite imageries, 2022)

The results of the analysis for year 2001 revealed that LST was 35°C across Inisa and its environs, while that of 2010 was 38.7°C. This increase is as a result of increasing impervious surface (built-up areas and bare land). Landuse/landcover analysis showed appreciable increase between 2001 and 2010, the built-up area increased from 515.07 hectares to 868.77 hectares (Figure 7). Most of the LULC that experienced 35C° to 38.7°C LST were built-up areas and bare land.

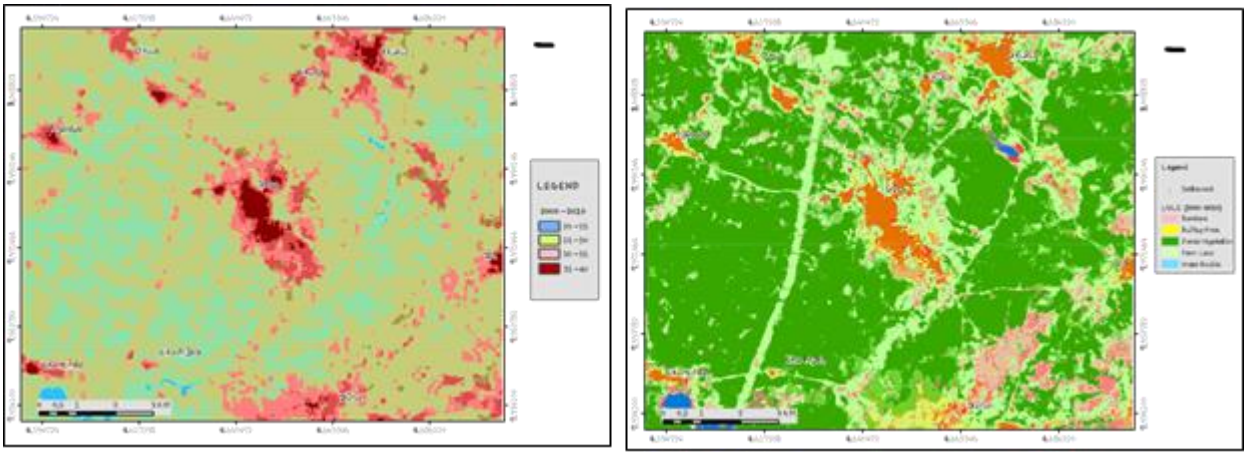

Figure 7 Mean Characteristics of LST across Inisa, 2001-2010 and Landuse/Land Cover Type for Inisa Environ 2001-2010
(source: Processed from Satellite Imageries, 2022)

Analysis for the year 2021 revealed spread in LST of 35°C across Inisa environ while the hottest LST across Inisa environs in 2021 is 40°C. This increase is as a result of increasing impervious surface (built-up areas and bare land). Landuse / landcover analysis shows that between 2011 and 2021, there is increase in built-up areas from 868.77 hectares to 2,015.29 hectares. (Figure 8). Most of the LULC that experienced 35C° to 40°C LST were mostly built-up areas and bare land.

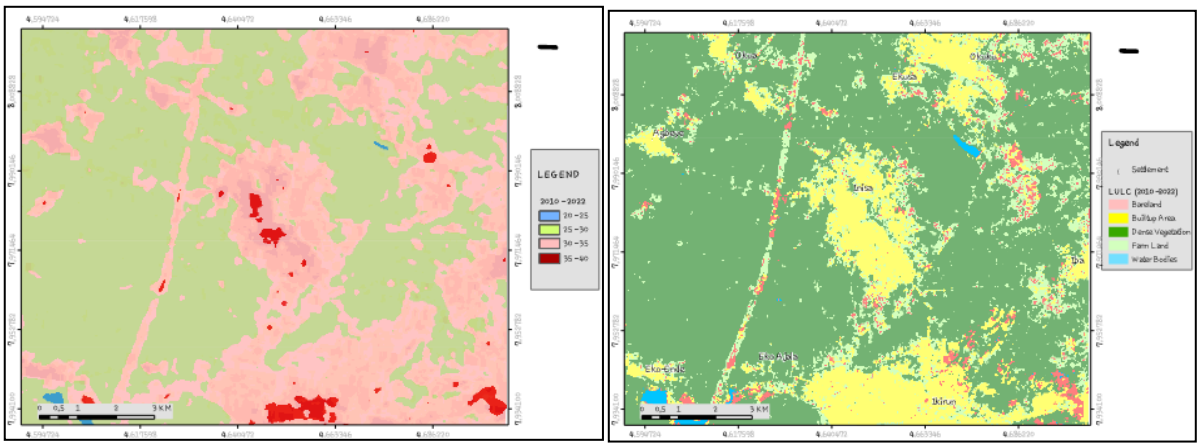

Figure 8 Mean Characteristics of LST across Inisa, 2010-2021and Landuse/Land Cover Type for Inisa Environ 2011-2021
(source: Processed from Satellite Imageries, 2022)

The results indicated an increase in the land surface temperature (LST) from 1990 to 2021 in Inisa and its environs. This could be attributed to the increasing amount of man-made elements that absorb and release heat, such as asphalt and bricks. The study also revealed that the densely vegetated areas in 1990 have diminished due to urban and infrastructural development, including buildings and roads, between 1990 and 2021.

It is possible to observe changes in Land Use/Land Cover (LULC) that affect the emissivity and spectral signature of the land surface using remote sensing techniques. These changes have contributed to significant alterations in climatic elements and have also modified the land surface temperature, influencing the development of the urban heat island effect. This is evident from the high relative humidity (RH) experienced in Inisa and its environs, with RH being high during the rainy season when temperatures are lower (generally between 87% and 90%) from June to October and lower during the dry season from December to March (ranging from about 55% to about 72%).

The spatial dynamics of land cover in Inisa and its environs from 1990 to 2021 are periodically presented in Figures 6, 7, and 8. The land covers were classified into five types: Built-up area, Waterbody, Barren land, Vegetation, and Farmland (Table 2). Built-up areas increased from 2.54% (332.01 hectares) in 1990 to 15.41% (2015.29 hectares) in 2021, an increase of 506.997%, indicating significant housing and service infrastructure development. Farmland was 4001.31 hectares (30.59%) in 1990 and increased by 8.217% to 4330.11 hectares (33.11%) in 2021. In addition to the increasing housing and communication infrastructure, farmland has expanded. However, its expansion is below expectation, considering the growth of housing and communication routes witnessed in Inisa and its environs. Dense vegetation decreased from 62.25% (8142.07 hectares) in 1990 to 46.07% (6025.63 hectares) in 2021, reflecting spatial dynamism resulting from population increase and associated demand for land. Bare land comprised 4.13% of the total land area in 1990, including sand mining and rock outcrop sites that have remained unchanged. The 2.54% built-up areas represent the areal extent of Inisa as of 1990. Meanwhile, wetlands and water bodies occupied 0.49% of the land area around Inisa. The five land cover types exhibit considerable inter-annual variations between 1990 and 2021. There was a significant increase in farmland and built-up areas (settlement), while vegetative cover significantly decreased. Although bare land covers 4.13% of the land area, quarrying activities in

the nearby town of Ikirun impact the barren land in the southern parts of Inisa. Both bare land and built-up areas significantly affect LST and other physical processes.

Table 2 LULC 1990 to 2021

1990			2000		
Landuse/Landcover Type	**Hectares**	**%**	**Landuse/Landcover Type**	**Hectares**	**%**
Built-up Area	332.01	2.54	Built-up Area	515.07	3.94
Farm land	4001.31	30.59	Farm land	4015.44	30.70
Bare land	539.96	4.13	Bare land	697.41	5.33
Dense Vegetation	8142.07	62.25	Dense Vegetation	7789.42	59.56
Water Bodies	63.45	0.49	Water Bodies	61.46	0.47
Total	**13078.80**	**100.00**	**Total**	**13078.80**	**100.00**
2001			**2010**		
Built-up Area	685.71	5.24	Built-up Area	702.65	5.37
Farm land	1123.38	8.59	Farm land	1109.25	8.48
Bare land	3541.05	27.07	Bare land	3783.6	28.93
Dense Vegetation	7643.25	58.44	Dense Vegetation	7405.9	56.63
Water Bodies	85.41	0.65	Water Bodies	77.4	0.59
Total	**13078.80**	**100.00**	**Total**	**13078.80**	**100.00**
2011			**2021**		
Built-up Area	1396.12	10.67	Built-up Area	2015.29	15.41
Farm land	1137.51	8.70	Farm land	4330.11	33.11
Bare land	3298.50	25.22	Bare land	623.16	4.76
Dense Vegetation	7153.25	54.69	Dense Vegetation	6025.63	46.07
Water Bodies	93.42	0.71	Water Bodies	84.61	0.65
Total	**13078.80**	**100.00**	**Total**	**13078.80**	**100.00**

Source: Obtained from Satellite Imageries, 2021

4.2 Implication for Physical Planning and Climate Change Mitigation

In urban climates, land surface temperature (LST) is a key indicator of the energy balance. It modifies the air temperature in the lower parts of the atmosphere due to changes in biophysical elements such as vegetation, impervious surfaces, and albedo, according to Sobrino et al. (2003) and Coll et al. (2005). At the interface between the surface and atmosphere, interactions and energy flows are significantly influenced by LST. The local weather and climate may also be impacted by shifts in LST, along with net radiation, heat, and water balance. Zhi et al. (2020) utilized a geographically weighted regression (GWR) model for the Xigang District of Dalian City, China, to investigate the link between spatial features and driving elements of LST. The findings highlighted the significance of the urban heat island effect in Xigang District, with LSTs at the end of August typically exceeding 28°C and primarily concentrated in the 38–40°C range. Urbanization has transformed the natural landscape of the Earth's surface, replacing vegetated areas with impermeable surfaces. For instance, buildings and paved roads cover the Earth's surface with concrete and asphalt, increasing the area's absorption of solar radiation and its thermal conductivity and capacity to release accumulated heat during the day and night. This process creates an urban heat island—a warmer climate than its surroundings. Remote sensing offers the advantage of being multitemporal and providing uniform planetary coverage, proving to be a powerful tool in various applications, including geomorphology and marine fisheries. As a method to assess the impact of climate on planning policy, remote sensing has begun to be employed in establishing environmental policies, such as forest monitoring.

The planning and development of cities in developing nations increasingly rely on climate monitoring for informed planning and adaptation. Recognizing the potential range of land surface temperature (LST) growth in terms of size and spatial distribution, which considers the interior structure, texture, and urban footprint analysis, is essential. This understanding is crucial for determining how climate change will affect physical planning frameworks and adaptation strategies for human settlements. Therefore, urban design techniques that maximize mixed building heights and implement green and blue infrastructure are vital for reducing LST in Inisa and its surroundings.

Built-up areas typically exhibit higher temperatures, particularly in the tropics, which can cause extreme heat stress. Urban air pollution poses a health risk and can block solar radiation. Planning and constructing metropolitan regions in harmony with the environment and climate can mitigate many of the negative effects of urbanization. Energy-efficient urban planning and design can help reduce greenhouse gas emissions, thereby lessening the threat of global climate change, as urban areas are major energy consumers. A stringent physical development policy regarding land uses and allocation, with considerable emphasis on green spaces, is necessary due to the high mean temperature of built-up areas. Although the relative LST of built-up sites has higher values than other land uses, it is evident that action is required.

The study's findings should inform urban planning for landscape design. It has been shown that land uses with abundant vegetation, particularly in farm and water-dominated areas, reduce the amount of LST and maintain cooler surface temperatures. Due to being surfaced with asphalt and other impermeable materials that absorb heat, most paved locations exhibit higher LSTs. Incorporating LST analysis into land use planning would aid in achieving sustainability and heat reduction. An overlay of impervious surfaces within the spatial planning scheme can indicate the potential heat generation, facilitating the recommendation of mitigation actions, particularly concerning the proportion of green space that must be appropriately utilized to reduce heat.

5. CONCLUSION

Satellite remote sensing techniques have enabled the determination of land surface temperature (LST) and the biophysical characteristics of various land use types. Planning guidelines that incorporate novel contributions from climatic indicators would greatly benefit from studies that connect a climatic approach to urban planning. We recommend giving built-up areas and communication routes priority for implementing heat mitigation treatments based on the findings of this work. Four methods are suggested for cooling Inisa environs: 1) increasing the quantity of vegetation within and around other landuses, with greater coverage and coherence; 2) considering the materials for road construction during regeneration/development; 3) widening the distance and adding more vegetation between buildings; and 4) avoiding the construction of buildings in wetlands. These efforts could be carried out by incorporating research and advice on the characteristics of the built environment for lower temperatures into urban regeneration plans, construction regulations, and urban/landscape design. Although context is important, subsequent research may want to evaluate the effectiveness of these techniques in nearby cities like Osogbo or Ikirun. To develop a more thorough understanding of how to improve the climatic resilience of expanding human settlements, attention should also be paid to other environmental implications, such as energy use, air pollution, and ventilation, generated from these cooling measures.

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ASSESSMENT OF EDUCATIONAL FACILITIES IN OSOGOBO METROPOLIS NIGERIA

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ABSTRACT

This study assessed educational facilities in the Osogbo metropolis, Nigeria, aiming to evaluate the available educational facilities, examine student and staff satisfaction levels, and analyze their availability across schools in the area. The sample consisted of 476 schools, from which 73 were randomly selected. A multistage sampling procedure was employed to sample 1,863 pupils/students and 87 teachers for questionnaire administration, complemented by observation. Data were analyzed using Mean Weighted Average, Summation of Weighted Value, and Analysis of Variance. Findings showed that 63.4% of primary schools had the listed facilities, while 75% of secondary schools reported 81% availability. Public primary school students reported a mean satisfaction level of 2.48, compared to 3.17 for private school students. Private secondary school students reported a satisfaction level of 3.84, against 2.57 for public school students. Staff satisfaction levels were 1.85 (public primary), 3.19 (private primary), 2.21 (public secondary), and 3.43 (private secondary). Variations and inadequacies in facilities across schools were established. F-ratios yielded $p<0.05$ for all variables except science laboratories/rooms, indicating significant differences. The study concluded that educational facilities were inadequate, and both students and staff were dissatisfied with the condition of the facilities. It recommends strengthening monitoring agencies to improve school supervision and education delivery.

Keywords: Educational facilities; Facility planning and management; Facility provision; Primary school; Secondary school

1. INTRODUCTION

The benefits of education are manifold for both individuals and the nation (Olayode et al., 2022). It is pivotal in the Sustainable Development Goals (SDGs), particularly Goal 4, which aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. This goal underscores education's vital role in fostering sustainable development and creating a more inclusive society. Education empowers individuals, enabling them to contribute positively to society (IIEP-UNESCO, 2020; Assad et al., 2023). Thus, the quality and availability of educational facilities, alongside human and physical resources, are crucial for the educational system's effectiveness in providing access to its primary beneficiaries—students and staff (NESSET, 2018). It is in line with SDG 4's Target 4.a, which calls for nations to construct and upgrade education facilities that cater to the needs of children, are disability and gender-sensitive, and offer safe, non-violent, inclusive, and effective learning environments for all. As defined by Ememe et al. (2019), educational facilities include resources, components, tools, and materials provided by schools to enhance teaching and learning. These range from classrooms, staff rooms,

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And administrative blocks to workshops, dormitories, libraries, laboratories, and more, encompassing both instructional and recreational spaces and facilities for health, residential purposes, and general use like minimarts, eateries, and internet access, to motivate the educational process (Arinze, 2019).

Educational facilities are among the government's most vital social services, directly and indirectly fostering societal and national development. Both private individuals and groups have complemented government efforts by establishing private educational institutions at various levels—primary, secondary, and tertiary—to facilitate easier access to education for the intended populace. Education's role in human growth is undeniable, necessitating sufficient provision to ensure quality education for all (World Bank, 2018; Ogundahunsi et al., 2018).

Despite significant investment in Nigeria's education sector, the outcomes in terms of quality and standards have fallen short of stakeholders' expectations. Akindutire et al. (2011) highlighted the impact of political leadership on resource allocation, which influences the distribution of financial resources through budgetary appropriations. This system allows the political class to control the total expenditure on education and its allocation, often bypassing proper procedures. Such practices frequently result in polarization, referred to by Akindutire et al. (2011) as adverse redistribution, where redistributive policies favor political leaders' constituencies, often reflecting regional and ethnic biases. Beyond unequal distribution, political figures also embezzlement funds meant for public services like education, health, and water, further undermining the sector's efficiency.

The Federal Republic of Nigeria (2013) highlighted that the effective delivery of educational programs in the country relies on adequate funding at all government levels. This necessitates significant annual budget allocations to the education sector. Achieving educational objectives, however, depends not just on funding but also on providing and maintaining quality learning environments that enhance efficiency and student performance. This underlines the importance of this research, which aims to assess the availability and condition of educational facilities in Osogbo Metropolis, Nigeria, to identify areas needing improvement.

2. LITERATURE STUDY

2.1 Theory of Infrastructure-led Development

The concept of infrastructure-led development, outlined by Agénor (2010), suggests that public investment in infrastructure can drive long-term economic growth. This principle has been extended to educational policy by Sabelli (2013), who stresses the importance of diverse forms of infrastructure, including conceptual frameworks, human capacity, and continuous funding, for educational progress. Grigg (2000) emphasizes incorporating skill training into educational infrastructure, such as problem-solving and public engagement. Hopkins (2015) delves deeper into the reconfiguration of school systems, underlining how educational infrastructure supports teaching and leadership practices. Infrastructure development, particularly in education, is crucial for creating sustainable human settlements (Rao, 2013). This is important in primary education, where infrastructure quality significantly affects student development and well-being. Ostwal (2021) argues that lacking functional infrastructure and facilities leads to substantial instructional development losses and negatively impacts educational outcomes. Education quality is often gauged by the availability of facilities and infrastructure, which are critical to the success of educational processes. Educational facilities and infrastructure markedly influence learning efficiency, both in and out of the classroom (Darmastuti, 2014).

Infrastructure-led development in education policy is a strategy that prioritizes investment in physical infrastructure—such as school buildings, classrooms, and technology—to enhance educational outcomes. This approach focuses on creating a conducive learning environment, supporting effective teaching practices, and ensuring equitable access to facilities and resources, fostering a productive

education system that contributes to societal growth and development. Equitable access means making facilities and resources available within reasonable distances for all users, aligning with the goals of sustainable human settlement as emphasized by SDG 4. Moreover, communities' quality is intrinsically linked to the quality of their schools, and vice versa. Schools serve as physical and social infrastructure, meeting the community's needs and playing a crucial role in the reciprocal relationship between educational quality and community well-being.

2.2 State of Educational Facilities in Nigeria.

The state of educational facilities in Nigeria has been extensively discussed in planning literature, noting that these facilities encompass the entire setting and environment where teaching and learning occur. This includes the physical location, buildings, equipment, green spaces or sports complexes, and essential structures like libraries, laboratories, and classrooms. Effective educational infrastructure is characterized by a physical environment that is comfortable, safe, secure, accessible, well-lit, ventilated, aesthetically pleasing, and conducive to efficient educational programs. The significance of adequate infrastructure for effective learning and comprehensive education delivery has been well-documented in the literature (Ruhyana and Aeni, 2019; Barrett et al., 2018; Yangambi, 2023; Root, 2023; Kul, 2021). Fabiyi and Ogunyemi (2015) highlighted that a society's progress depends on its ability to identify and cultivate intellectual potentials and to effectively utilize them, suggesting that building educational capacity is fundamental to societal and national development.

Private primary and secondary schools in Nigeria typically offer superior educational facilities to their public counterparts. Studies show that private schools excel in maintaining school records and infrastructure (Atanda & Olaifa, 2022; Abba & Nura, 2023), enforce stricter discipline and staff control (Olabimpe et al., 2022), and lead in school health programs with fewer health hazards present on their premises (Ihearindueme & Emujakporue, 2022). Additionally, private schools invest significantly in delivering functional educational services, including libraries and laboratory equipment (Egbebi & Wakili, 2020).

Conversely, the scarcity of educational facilities in public primary and secondary schools is a common issue in Nigeria and other nations, posing a significant obstacle to achieving Goal 4 of the Sustainable Development Goals set by the United Nations in 2015. Research by Izobo-Martins (2014) in Ogun State, Nigeria, found much of the infrastructure in public secondary schools in disrepair, affected by user attitudes, a lack of maintenance culture, and inadequate funding. Nkong et al. (2016) discovered a significant positive correlation between school facilities and educational quality in Cameroon's public primary schools. Similar findings were reported by Ojeje and Adodo (2018) in Delta State, Nigeria, and Likuru and Mwila (2022) in Tanzania, who noted crowded classrooms as a learning impediment. Nasuna et al. (2022) observed that inadequate infrastructure negatively impacts student enrollment in Uganda. These studies recommend proactive measures by governments and stakeholders to improve conditions, ensuring the future generation receives adequate education to fulfill their societal roles. This study assesses the adequacy of educational facilities in both public and private primary and secondary schools in the Osogbo metropolis.

2.3 Study Area

Osogbo Metropolis, located in South-Western Nigeria, has experienced rapid growth since the Osogbo Metropolis, situated in South-Western Nigeria, has witnessed significant growth since Osun State was established in 1991. Serving as the state capital, it encompasses Osogbo Local Government, Olorunda Local Government, and portions of Egbedore Local Government Areas. The city is characterized by a humid tropical climate, receiving an average annual rainfall of 1700 cm and situated 391m above sea level. As of 2023, the estimated population is 630,165, with a yearly growth rate of 3%. Traditionally, the local economy has been dominated by farming and fabric painting. However, the construction of the railway has turned Osogbo into a bustling commercial hub, revitalizing areas like Old Garage, Dugbe, Orisunmbare, MDS, Oke-Fia, and Olaiya. Key markets

within the city include Akindeko-Alekunwodo Market, Oke-Fia Market, Orisunmbare Market, and Oja Oba.

2.4 Primary and Secondary Schools in Osogbo Metropolis

Based on the data from Osun State Ministry of Education and Authors compilation in 2023, the metropolis has fifty-one (51) public primary schools, three-hundred and five (305) private primary schools, twenty-eight (28) public secondary schools, and ninety-nine (91) private secondary schools, making a total of four-hundred and seventy-five (475) primary and secondary schools (see Figure 1).

Figure 1 Osun State within the Context of Nigeria

Figure 2 displays the Osogbo Metropolis within the context of Osun State, while Figure 3 specifically illustrates the Osogbo Metropolis.

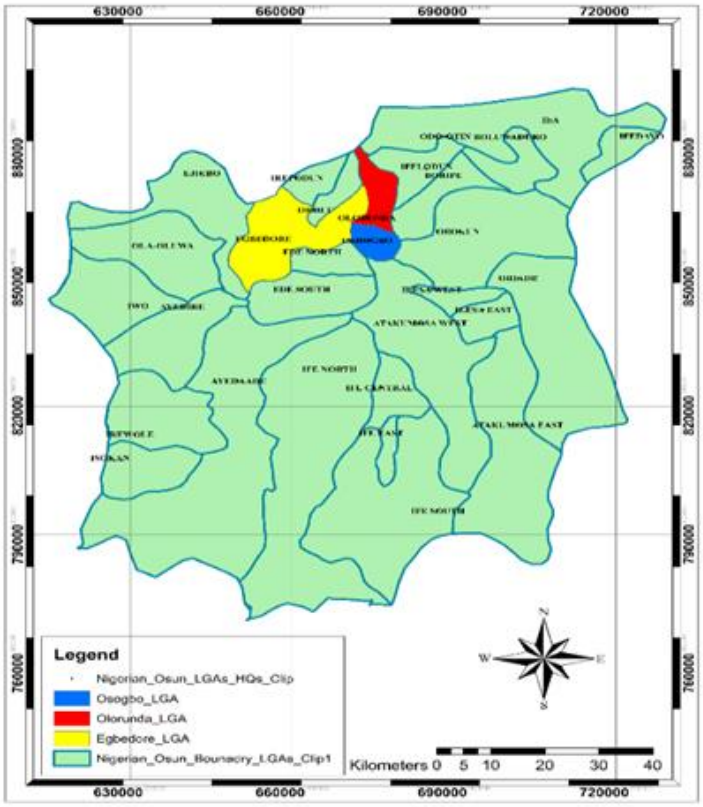


Figure 2 Osogbo Metropolis within the Context of Osun State

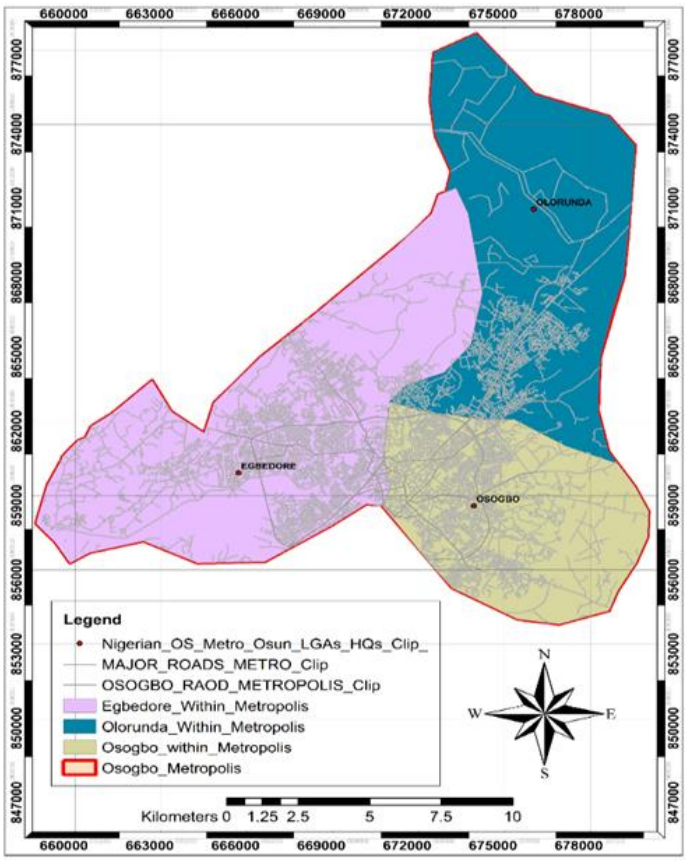


Figure 3 Osogbo Metropolis

3. METHODOLOGY

This research employed both primary and secondary data sources. Primary data were gathered directly from students and teachers in the selected schools. Secondary data included the school directory and student enrollment figures obtained from the State Ministry of Education in Osun State. Other secondary sources encompassed publications on education, facility planning, and management from the Ministry of Works and Transport and the Osun State University library. According to the Ministry of Education, Osogbo metropolis houses 51 public primary schools, 305 private primary schools, 28 public secondary schools, and 91 private secondary schools.

Considering constraints related to time, cost, and logistics, a sample size of 15% was determined for this study, inclusive of teachers, students, and parents, as supported by references such as Afon et al. (2016), Adedotun (2016), Ogundahunsi (2017), Omisore et al. (2019), and Olowoporoku et al. (2019). A multistage sampling method was applied. Initially, schools were categorized into primary and secondary levels, which were then further divided into public and private institutions. Subsequently, one out of every seven schools (15%) were selected through a balloting method without replacement. As a result, the study included eight public primary schools, 46 private primary schools, five public secondary schools, and 14 private secondary schools, totalling 54 primary and 19 secondary schools sampled within the Osogbo metropolis.

The data from the Osun State Ministry of Education provided the number of students and staff, establishing the study's population. A systematic and random sampling method was applied to select 5% of students from each of the chosen schools, resulting in a sample of 1,863 students—412 from public primary schools, 571 from private primary schools, 565 from public secondary schools, and 315 from private secondary schools. Additionally, 5% of the staff across the schools were sampled, totalling 87 staff members, with 10 from public and 51 from private primary schools, and 10 from public and 16 from private secondary schools. Consequently, the study surveyed a total of 1,950 respondents, including 1,863 students and 87 staff members. Staff numbers were adjusted upwards in cases of decimals. The analysis employed Mean Weighted Value and Summation of Weighted Value for a comparative assessment of the facilities. Analysis of Variance (ANOVA) was used to examine the variability of facilities across schools.

4. RESULTS AND DISCUSSION

4.1. Availability of School Facilities as Indicated by Staff Members

The analysis of staff responses highlighted differences in the availability of facilities between public and private schools. Private primary schools demonstrated a 66.3% availability of facilities, surpassing the 52.6% in public schools. Notably, private primary schools provided science laboratories, fire suppression systems, computer and ICT facilities, libraries, and sick bays, which were absent in their public counterparts. Public primary schools had advantages only in the presence of the Principal's office and playgrounds, although these were also available in private schools. Across both school types, all teachers confirmed the presence of structurally sound buildings, separate classrooms for various levels, safety and security measures on the premises, adequate desks and chairs, classrooms of appropriate size, canteens/cafeterias, teachers' offices, and sanitation facilities.

In the secondary school category, a similar pattern to the primary schools emerged, with private schools showing a 65.6% availability of facilities compared to 53.2% in public schools. Public secondary schools notably lacked fire suppression systems, computer and ICT facilities, science laboratories, libraries, and sick bays. All sampled schools, regardless of category, did not have boarding facilities, comprehensive sports facilities, home economics laboratories, workshops for

technical skill development, or facilities for individuals with special needs—elements crucial for delivering a fully equitable and effective education. However, like in primary schools, they all reported the availability of facilities such as structurally sound buildings, separate classrooms for different educational levels, safety and security measures, adequate numbers of desks and chairs, appropriately sized classrooms, canteens/cafeterias, teachers' offices, and sanitation facilities.

The superior performance of private primary and secondary schools compared to public ones was attributed to more stringent monitoring and supervision by the Ministry of Education, ensuring compliance with the standards and regulations outlined in the nation's education policy. Relevant government ministries, including the Ministries of Works, Health, and Education, assess the availability, quality, and quantity of facilities before approving establishing a private school, a level of scrutiny not consistently applied to public schools.

Table 1 Availability of Educational Facilities as Indicated by Members of Staff

S/N	Educational Facilities	Primary			Secondary		
		Public	Private	%	Public	Private	%
		Yes (%)	Yes (%)	Diff	Yes (%)	Yes (%)	Diff
1	School building in terms of fitness/stability, windows, doors, floor, ceiling, walls, etc.	100	100	0	100	100	0
2	Toilets for males and females	60	100	-40	100	100	0
3	Separate classrooms for different levels	100	100	0	100	100	0
4	Science laboratories/rooms	0	70.6	-70.6	0	70	-70
5	Computer rooms/laboratories	0	60.8	-60.8	0	60	-60
6	Safety and security within the school compound	100	100	0	62.5	100	-37.5
7	Safety and security within the school neighborhood	100	100	0	100	100	0
8	Fire suppression systems within the compound	0	60.8	-60.8	0	60	-60
9	Electricity and alternative energy sources	30	60.8	-30.8	37.5	60	-22.5
10	Workshops for practical/technical skills development	0	0	0	0	0	0
11	Playground	100	49	51	100	50	50
12	School building designed for students with special need	0	0	0	0	0	0
13	Adequate number of desks and chairs for students	100	100	0	100	100	0
14	Size of classrooms	100	100	0	100	100	0
15	Availability of ICT facilities	0	51	-51	0	50	-50
16	Library	0	51.9	-51.9	0	50	-50
17	Home Economics Laboratories/rooms	0	0	0	0	0	0
18	Sickbay or clinics	0	70.6	-70.6	0	70	-70
19	Canteen/ Cafeteria	100	100	0	100	100	0
20	Sports facilities include a football pitch, volleyball,	0	0	0	0	0	0

	basketball, table tennis, swimming pool, hockey pitch, etc.						
21	Teachers' office	100	100	0	100	0	100
22	Principals' office	100	39.2	60.8	100	100	0
23	Neatness of the general physical environment in terms of surrounding activities	100	100	0	100	100	0
24	Maintenance and repairs	30	76.5	-46.5	37.5	100	-62.5
25	The neatness of the entire school compound	100	100	0	100	100	0
26	Boarding facilities	0	0	0	0	0	0
27	Sanitation facilities	100	100	0	100	100	0
Total (Frequency and %)		**52.6**	**66.3**	**-13.7**	**53.2**	**65.6**	**-12.4**

Source: Authors' Fieldwork, 2023

Given the critical role of infrastructure and facilities in education's success, their presence often serves as a measure of education quality. The availability of educational infrastructure and amenities within classrooms and the broader school environment significantly influences learning effectiveness. This suggests that the observed decline in secondary school students' performance in the West African Senior School Certificate Examination over the last decade can be linked to the state's deteriorating and insufficient educational infrastructure. Data from the National Bureau of Statistics (NBS) for 2019 to 2021 show a decrease in the percentage of candidates achieving credit in five subjects, including English Language and Mathematics, from 66.8% to 65.99% in private schools and from 50.16% to 32.55% in public schools. This trend reflects the state of infrastructure in both school categories and corroborates this study's findings on the availability of educational facilities in private and public schools. Private schools performed better than public schools, attributed to their superior infrastructure. While infrastructure may not be the sole factor affecting performance, it is undoubtedly a significant element in the educational framework. Supporting the infrastructure-led development theory, Ostwal (2021) posited that the absence of well-maintained facilities and infrastructure leads to substantial losses in instructional development and time, adversely affecting educational outcomes. Consequently, substantial investments in educational facilities are proposed as a solution, anticipated to yield a multiplier effect on student performance, skill acquisition, socialization, leadership training, and neighborhood development.

4.2 Satisfaction Rating of Available Educational Facilities

Students and staff evaluated their satisfaction with various facilities using a five-point Likert scale, ranging from 'Not at all satisfied (1)' to 'Very satisfied (5)'. Satisfaction levels were quantified using the Students' Satisfaction Index (SRI) for students and Staff Satisfaction Index (SRII) for staff, applying the Mean Weighted Value (MWV) method, aligning the satisfaction with infrastructure needs on a 0 – 5 scale.

In private schools, students rated facilities significantly higher than their peers in public schools, both at primary and secondary levels. In public primary schools, students expressed dissatisfaction with several facilities, including toilets (SRI=1.89), computer labs (SRI=1.37), fire suppression systems (SRI=1.69), sick bays (SRI=1.59), canteens (SRI=1.53), and teachers' offices (SRI=1.92), citing inadequacy. Conversely, students in private primary schools gave higher ratings, with toilets (SRI=3.40) and science/computer labs (SRI=3.77) deemed satisfactory. Notably, public primary students rated safety and security (SRI=3.48), separate classrooms for different levels (SRI=3.85), and classroom size (SRI=3.86) higher than those in private schools. On average, public primary

students reported a 52.2% satisfaction level (SRI=2.61), while private school students reported a 65% satisfaction level (SRI=3.25).

The pattern was similar in secondary schools, with private school students showing a higher overall satisfaction level of 79% (SRI=3.95) compared to 52.4% (SRI=2.62) in public schools. For example, private school students rated gender-specific toilets (SRI=4.43), science labs (SRI=4.07), separate classrooms (SRI=4.60), safety and security (SRI=4.58), playgrounds (SRI=4.34), ICT facilities (SRI=4.11), and maintenance and repairs (SRI=4.12) significantly higher than their public school counterparts, highlighting a discrepancy in satisfaction levels attributable to differences in facility provision and maintenance.

The ratings provided by students underscore that private school facilities are superior in quality and quantity and are better managed and maintained than public schools. This disparity is linked to the stringent standards private schools must adhere to before operation and regular monitoring to ensure ongoing compliance with these standards. In contrast, public schools established by various government tiers do not undergo the same scrutiny. Additionally, the vast number of public schools and limited government financial resources lead to neglect of facilities. The absence of tuition fees in public schools, which could supplement government funding, further exacerbates this issue. Consequently, ICT, library, electricity, science laboratory, and toilet facilities in public schools received lower ratings, reflecting the impact of these challenges on the availability and condition of essential educational facilities.

Table 2 Students Facilities Satisfaction Rating

S/N	School Facilities	School Type						Aggregate Mean
		Primary school Mean			Secondary school Mean			
		Public	Private	Total	Public	Private	Total	
1.	School building in terms of fitness/stability, windows and doors, floor, ceiling, walls, etc.	3.86	4.15	4.0	3.11	3.15	3.13	3.57
2.	Toilets for males and females	1.89	3.40	2.6	2.20	4.43	3.32	2.96
3.	Separate classrooms for different levels	3.85	3.13	3.5	3.16	4.60	3.88	3.69
4.	Science laboratories/rooms	2.21	3.77	3	2.19	4.07	3.13	3.07
5.	Computer rooms/laboratories	1.37	3.60	2.5	2.41	3.95	3.18	2.84
6.	Safety and security within the school compound	3.48	2.88	3.2	3.05	4.14	3.60	3.4
7.	Safety and security within the school neighborhood	3.58	3.00	3.3	3.32	4.58	3.95	3.63
8.	Fire suppression systems within the compound	1.69	2.43	2.1	2.13	3.96	3.05	2.58
9.	Electricity and alternative energy sources	2.04	3.14	2.6	2.07	3.66	2.87	2.74
10.	Playground	3.11	3.25	3.2	3.68	4.34	4.01	3.61
11.	Adequate number of desks and chairs for students	3.57	3.87	3.7	3.03	4.33	3.68	3.69
12.	Size of classrooms	3.86	2.95	3.4	3.40	3.88	3.64	3.52
13.	Availability of ICT facilities	2.04	2.81	2.4	1.90	4.11	3.01	2.71
14.	Library	2.05	3.40	2.7	2.24	4.19	3.22	2.96

S/N	School Facilities	School Type						Aggregate Mean
		Primary school Mean			Secondary school Mean			
		Public	Private	Total	Public	Private	Total	
15.	Sickbay or clinics	1.59	3.80	2.7	2.32	3.67	3.00	2.85
16.	Canteen/ Cafeteria	1.53	2.83	2.2	2.55	3.34	2.95	2.58
17.	Sporting facilities-football pitch, volleyball court, basketball court, table tennis, swimming pool, hockey pitch, etc	2.12	3.15	2.6	2.21	3.43	2.82	2.71
18.	Teachers' office	1.92	2.47	2.2	3.18	4.28	3.73	2.97
19.	Principals' office	2.54	3.02	2.8	2.54	3.78	3.16	2.98
20.	Neatness of the general physical environment in terms of surrounding activities	3.21	3.18	3.2	2.70	3.42	3.06	3.13
21.	Maintenance and repairs	2.72	4.07	3.4	2.68	4.12	3.40	3.4
22.	The neatness of the entire school compound	3.35	3.32	3.3	2.13	4.02	3.08	3.19
23.	Sanitation facilities	2.46	3.14	2.8	2.05	3.43	2.74	2.77
Mean Cumulative		**60**	**74.8**	**67.4**	**60.3**	**90.9**	**75.6**	**71.6**
Mean Aggregate		**2.61**	**3.25**	**2.93**	**2.62**	**3.95**	**3.29**	**3.11**

Source: Authors' Fieldwork, 2023

4.3 Staff Satisfaction with School Facilities

The staff satisfaction ratings further emphasize the disparity in facility quality and management between public and private schools. In public primary schools, the average satisfaction level was 1.97, indicating general dissatisfaction, while private primary schools showed mild satisfaction with an average of 3.41. Public primary school staff expressed dissatisfaction with most facilities, except for separate classrooms for different levels (SRII=4.5), safety and security (SRII=3.1), and classroom size (SRII=3.3). Conversely, private school staff gave high ratings to school buildings (SRII=4.39), safety and security (SRII=4.41), environment cleanliness (SRII=4.51), electricity and alternative energy sources (SRII=4.2), and maintenance and repairs (SRII=4.31). This alignment between staff and student ratings underscores the critical need to improve public school facilities to enhance learning effectiveness.

In public secondary schools, staff dissatisfaction was evident, with a satisfaction level of 2.31, whereas private secondary schools showed satisfaction at 3.56. Public secondary staff found all facilities unsatisfactory except for the school building's fitness and stability (SRII=2.88), separate classrooms (SRII=4.0), playgrounds (SRII=4.38), adequate desks and chairs (SRII=3.5), and classroom size (SRII=4.06). Private secondary staff were satisfied with most facilities, including school buildings (SRII=4.30), gender-specific toilets (SRII=4.10), and separate classrooms (SRII=4.80), except for playgrounds (SRII=2.20) and sickbay/clinic/first aid (SRII=1.80). These findings, consistent with the student assessments, highlight the urgent need for targeted investments in public school infrastructure to meet the essential standards for effective education delivery.

The alignment between staff and student satisfaction ratings illuminates the extent to which the current infrastructure meets the needs of both educators and learners. As pivotal components of

sustainable communities, educational institutions must be furnished with quality facilities that cater to the needs of their users.

The ArcGIS analysis, presented through Figures 4, 5, 6, 7, and 8, offers insight into the condition of various facilities. This geographical analysis can provide a detailed understanding of educational facilities' spatial distribution and condition, enabling targeted interventions for improvement. Such tools are essential for identifying areas most in need of investment and ensuring educational institutions are well-equipped to support effective learning environments and contribute to the community's overall well-being.

Table 3 Staff Facilities Satisfaction Rating

S/N	School Facilities	School Type						Aggregate
		Primary school Staff Mean			Secondary school Staff Mean			
		Public	Private	Total	Public	Private	Total	
1.	School building in terms of fitness/stability, windows, doors, floor, ceiling, walls, etc.	2.00	4.39	3.2	2.88	4.30	3.59	3.4
2.	Toilets for males and females	1.60	3.90	2.75	2.06	4.10	3.08	2.92
3.	Separate classrooms for different levels	4.50	3.20	3.85	4.0	4.80	4.4	4.13
4.	Science laboratories/rooms	1.30	2.49	1.9	2.4	4.30	3.35	2.63
5.	Computer rooms/laboratories	1.20	2.88	2.04	2.31	3.70	3.01	2.53
6.	Safety and security within the school compound	2.40	4.10	3.25	1.81	3.90	2.86	3.06
7.	Safety and security within the school neighborhood	3.10	4.41	3.76	2.56	3.70	3.13	3.45
8.	Fire suppression systems within the compound	1.40	3.71	2.56	1.94	3.50	2.72	2.64
9.	Electricity and alternative energy sources	1.60	4.20	2.9	1.81	3.80	2.81	2.86
10.	Playground	4.70	1.41	3.06	4.38	2.20	3.29	3.18
11.	Adequate number of desks and chairs for students	1.10	3.78	2.44	3.50	4.60	4.05	3.25
12.	Size of classrooms	3.30	3.78	3.54	4.06	4.30	4.18	3.86
13.	Availability of ICT facilities	1.10	3.69	2.4	1.75	3.30	2.53	2.47
14.	Library	1.10	3.29	2.2	1.75	3.00	2.38	2.29
15.	Sickbay or clinics	1.10	2.82	1.96	1.31	1.80	1.56	1.76
16.	Canteen/ Cafeteria	2.50	3.71	3.11	1.69	3.50	2.6	2.86
17.	Sporting facilities-football pitch, volleyball court, basketball court, table tennis, swimming pool, hockey pitch, etc	1.00	1.00	1	1.69	1.90	1.8	1.4
18.	Teachers' office	1.30	1.71	1.51	2.00	3.34	2.67	2.09
19.	Principals' office	1.40	3.29	2.35	1.56	3.10	2.33	2.34
20.	Neatness of the general physical environment in	2.50	4.51	3.51	1.69	3.70	2.7	3.11

S/N	School Facilities	School Type						Aggregate
		Primary school Staff Mean			Secondary school Staff Mean			
		Public	Private	Total	Public	Private	Total	
	terms of surrounding activities							
21.	Maintenance and repairs	1.10	4.31	2.71	1.75	4.00	2.88	2.8
22.	The neatness of the entire school compound	2.60	4.22	3.41	2.44	3.50	2.97	3.19
23.	Sanitation facilities	1.50	3.63	2.57	1.87	3.60	2.74	2.66
Mean Cumulative		**45.4**	**78.4**	**62**	**53.2**	**81.9**	**67.6**	**64.9**
Mean Aggregate		**1.97**	**3.41**	**2.69**	**2.31**	**3.56**	**2.94**	**2.82**

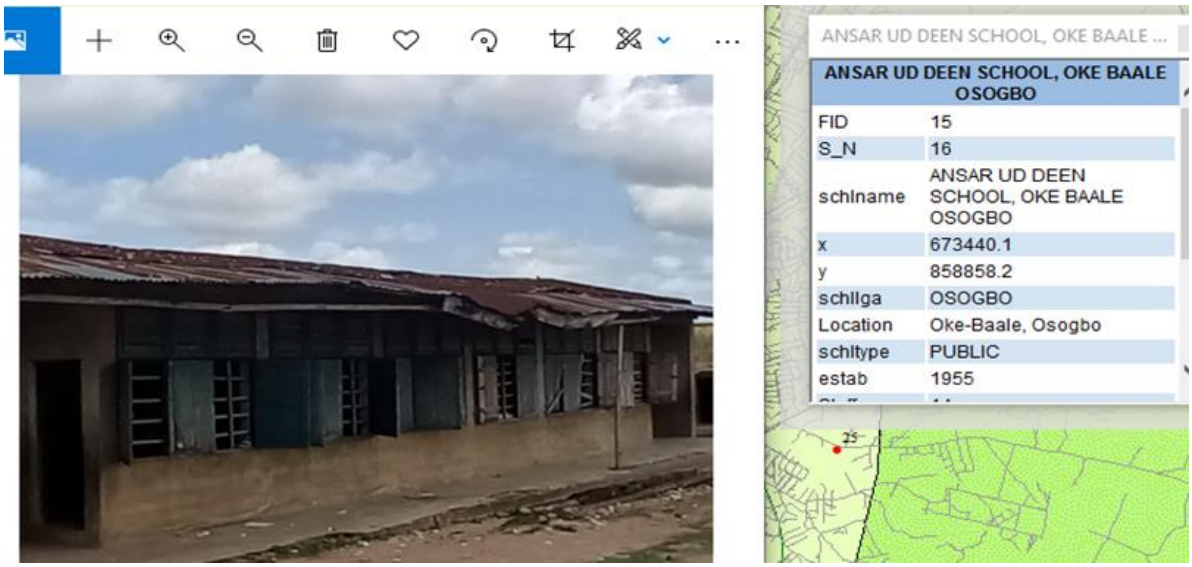


Figure 4 State of Classroom at Ansarudeen School, Oke-Baale of Osogbo Metropolis

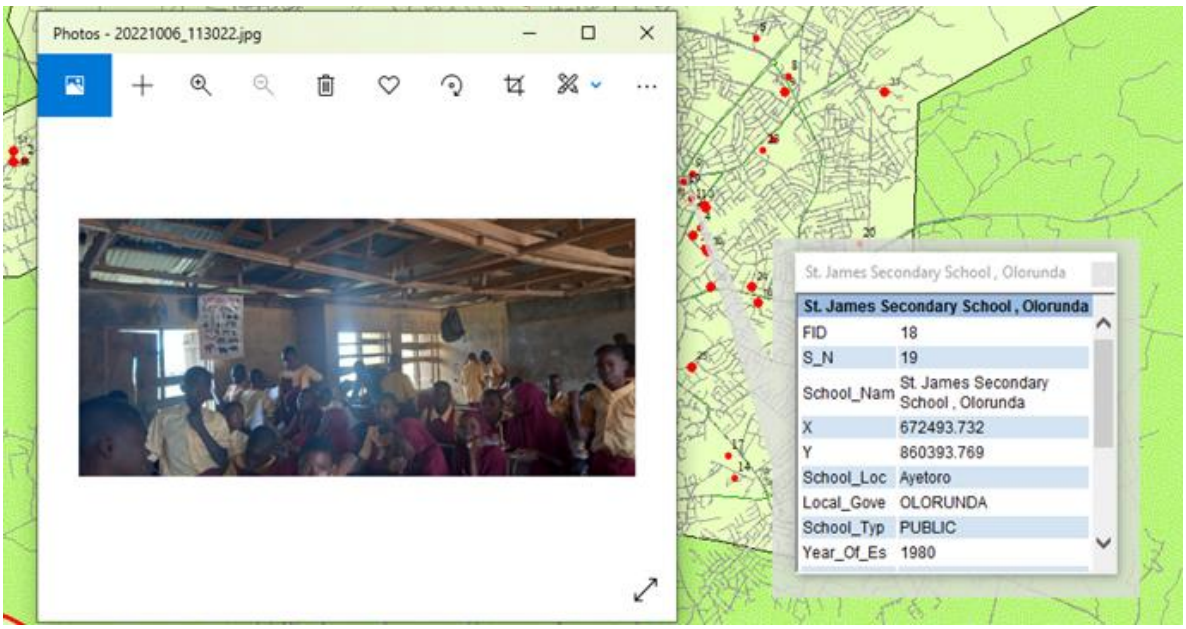


Figure 5 Condition of Claasroom as St. James Secondary Ayetoro, Osogbo Metropolis

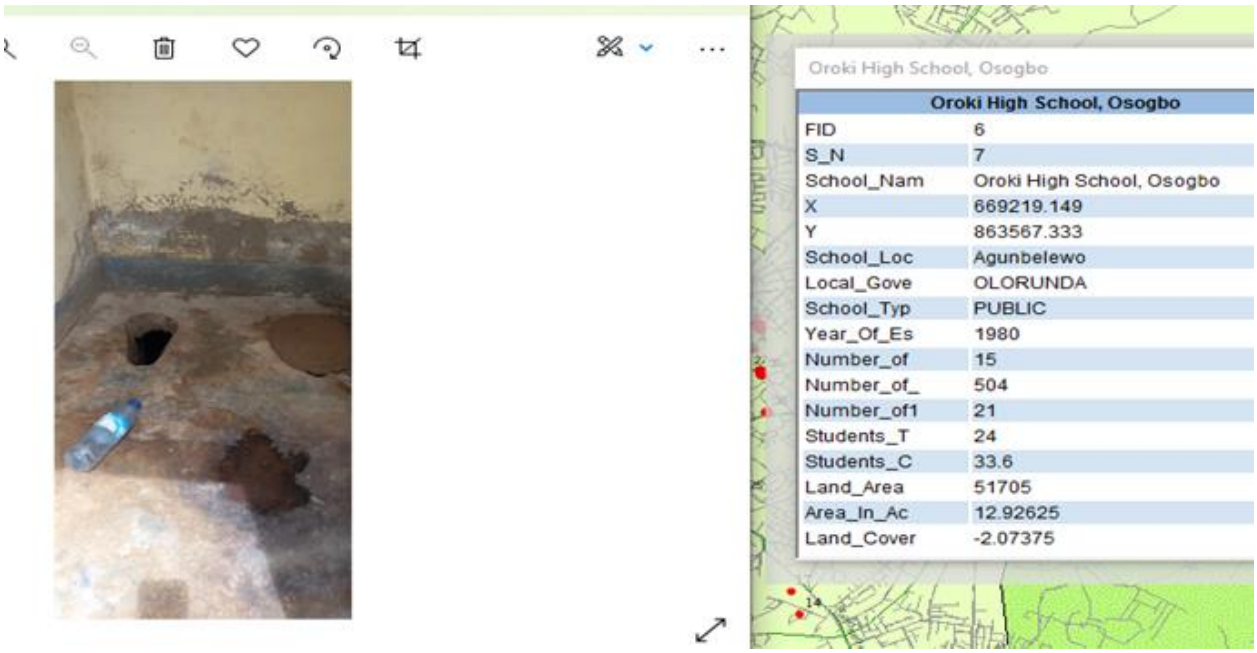


Figure 6 Toilet Facility Oroki High School, Agunbelewo, in Osogbo Metropolis

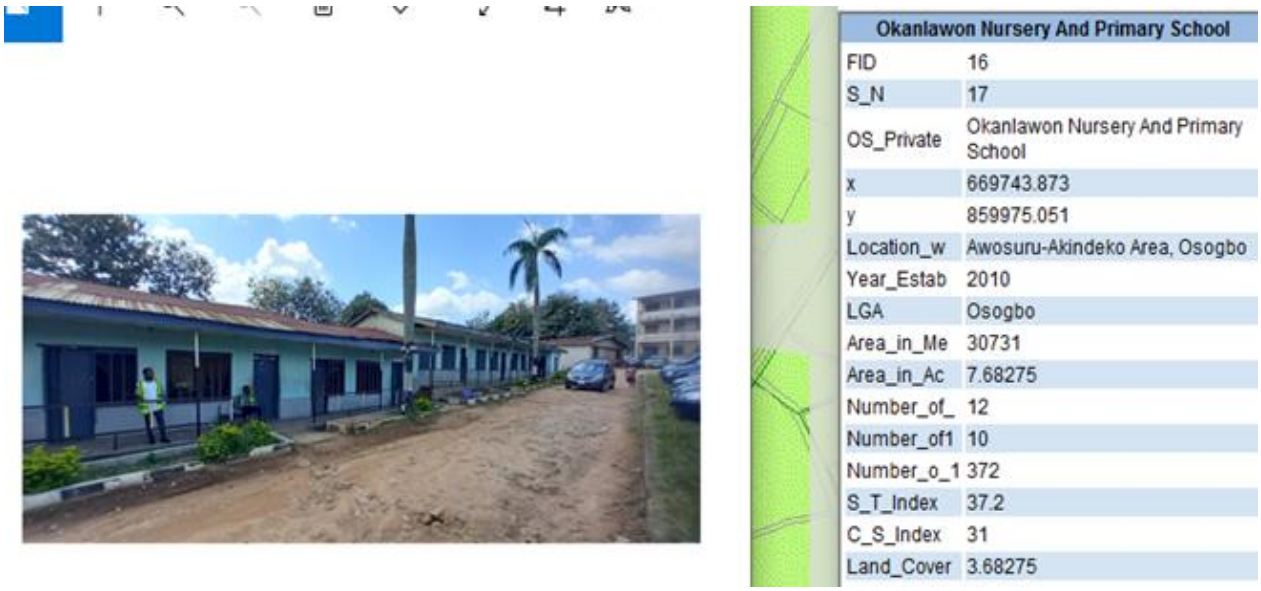


Figure 7 Condition of Classrooms at Okanlawon School of Science, Alekunwodo Area of Osogbo, Metropolis

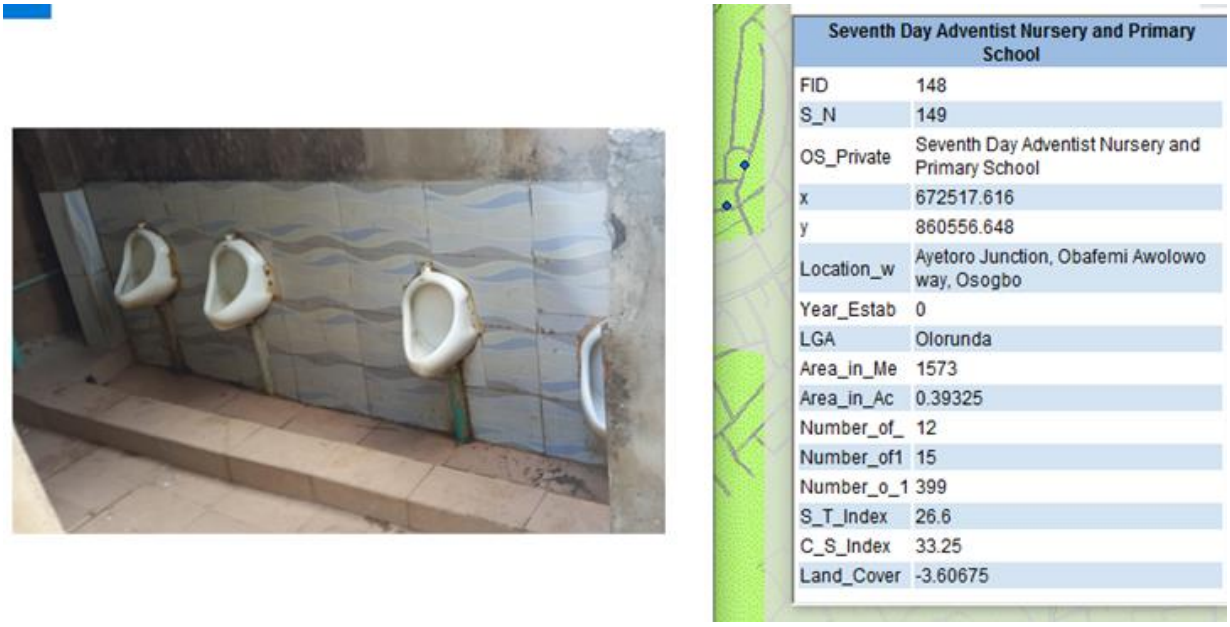


Figure 8 The Urinal at Seventh Adventist School, Ayetoro Area, of Osogbo Metropolis

4.4 Variation in the Available Facilities Across the Schools in Osogbo Metropolis

The examination of facility variation within primary and secondary and private and public schools in the Osogbo metropolis utilized Analysis of Variance (ANOVA). The results in Table 4 showed statistically significant differences across the school categories. The ANOVA results produced F-ratios, resulting in a p-value less than 0.05 ($p<0.05$) for several variables, indicating significant variation. These variables included the school building's fitness/stability, gender-specific toilets, separate classrooms for different levels or stratification, computer rooms, safety and security within and around the school compound, fire suppression systems, electricity and alternative energy sources, playgrounds, design considerations for students with special needs, classroom size, ICT facility availability, libraries, sickbays or clinics, canteens/cafeterias, sporting facilities, teachers' offices, principals' offices, maintenance and repairs, and sanitation facilities.

Conversely, variables such as science laboratories, adequate numbers of desks and chairs, classroom size, the neatness of the surrounding physical environment, and the overall cleanliness of the school compound showed no statistically significant differences across the schools, with p-values greater than 0.05 ($p>0.05$). Thus, the findings revealed a statistically significant variation in the availability and condition of school facilities in the Osogbo metropolis, highlighting areas where improvements are needed to ensure equitable access to quality educational infrastructure.

Table 4 Variation in the Available Facilities Across the Schools in Osogbo Metropolis

S/N	Variables		Sum of Squares	df	Mean Square	F	Sig.
1.	School building in terms of fitness/stability, windows, doors, floor, ceiling, walls, etc.	Between Groups	42.729	1	42.729	245.347	.000
		Within Groups	323.931	1860	.174		
		Total	366.660	1861			
2.	Toilets for males and females	Between Groups	49.323	1	49.323	306.362	.000
		Within Groups	299.614	1861	.161		
		Total	348.937	1862			
3.		Between Groups	.499	1	.499	8.635	.003

S/N	Variables		Sum of Squares	df	Mean Square	F	Sig.
	Separate classrooms for different levels	Within Groups	107.399	1860	.058		
		Total	107.897	1861			
4.	Science laboratories/rooms	Between Groups	.046	1	.046	.204	.652
		Within Groups	423.047	1860	.227		
		Total	423.093	1861			
5.	Computer rooms/laboratories	Between Groups	88.040	1	88.040	351.037	.000
		Within Groups	466.740	1861	.251		
		Total	554.780	1862			
6.	Safety and security within the school compound	Between Groups	30.480	1	30.480	136.244	.000
		Within Groups	416.333	1861	.224		
		Total	446.813	1862			
7.	Safety and security within the school neighborhood	Between Groups	10.112	1	10.112	79.932	.000
		Within Groups	235.434	1861	.127		
		Total	245.546	1862			
8.	Fire suppression systems within the school compound	Between Groups	24.495	1	24.495	103.377	.000
		Within Groups	440.959	1861	.237		
		Total	465.454	1862			
9.	Electricity and alternative energy sources	Between Groups	33.845	1	33.845	120.976	.000
		Within Groups	520.642	1861	.280		
		Total	554.487	1862			
10.	Playground	Between Groups	1.374	1	1.374	13.327	.000
		Within Groups	191.882	1861	.103		
		Total	193.256	1862			
11.	Adequate number of desks and chairs for students	Between Groups	.141	1	.141	2.178	.140
		Within Groups	120.787	1861	.065		
		Total	120.929	1862			
12.	Size of classrooms	Between Groups	.059	1	.059	.875	.350
		Within Groups	126.013	1861	.068		
		Total	126.072	1862			
13.	Availability of ICT facilities	Between Groups	74.889	1	74.889	356.601	.000
		Within Groups	390.823	1861	.210		
		Total	465.711	1862			
14.	Library	Between Groups	4.630	1	4.630	21.600	.000
		Within Groups	398.887	1861	.214		
		Total	403.517	1862			
15.	Sickbay or clinics	Between Groups	83.684	1	83.684	434.952	.000
		Within Groups	358.055	1861	.192		
		Total	441.739	1862			
16.	Canteen/cafeteria	Between Groups	36.668	1	36.668	165.484	.000
		Within Groups	412.360	1861	.222		
		Total	449.028	1862			
17.	Sporting facilities- football pitch, volleyball court, basketball court, table tennis, swimming pool, hockey pitch, etc	Between Groups	53.802	1	53.802	199.623	.000
		Within Groups	501.571	1861	.270		
		Total	555.373	1862			
18.	Teacher'' office	Between Groups	21.764	1	21.764	111.079	.000

S/N	Variables		Sum of Squares	df	Mean Square	F	Sig.
		Within Groups	364.630	1861	.196		
		Total	386.394	1862			
19.	Principal'' office	Between Groups	1.320	1	1.320	27.658	.000
		Within Groups	88.835	1861	.048		
		Total	90.156	1862			
20.	Neatness of the general physical environment in terms of surrounding activities	Between Groups	.424	1	.424	2.669	.103
		Within Groups	295.371	1858	.159		
		Total	295.795	1859			
21.	Maintenance and repairs	Between Groups	7.865	1	7.865	64.813	.000
		Within Groups	225.836	1861	.121		
		Total	233.702	1862			
22.	The neatness of the entire school compound	Between Groups	.195	1	.195	.859	.354
		Within Groups	421.835	1861	.227		
		Total	422.030	1862			
23.	Sanitation facilities	Between Groups	61.409	1	61.409	281.690	.000
		Within Groups	405.702	1861	.218		
		Total	467.111	1862			

Source: Authors' Fieldwork, 2023

Figure 9 depicts the spatial location of primary schools in the Osogbo Metropolis.

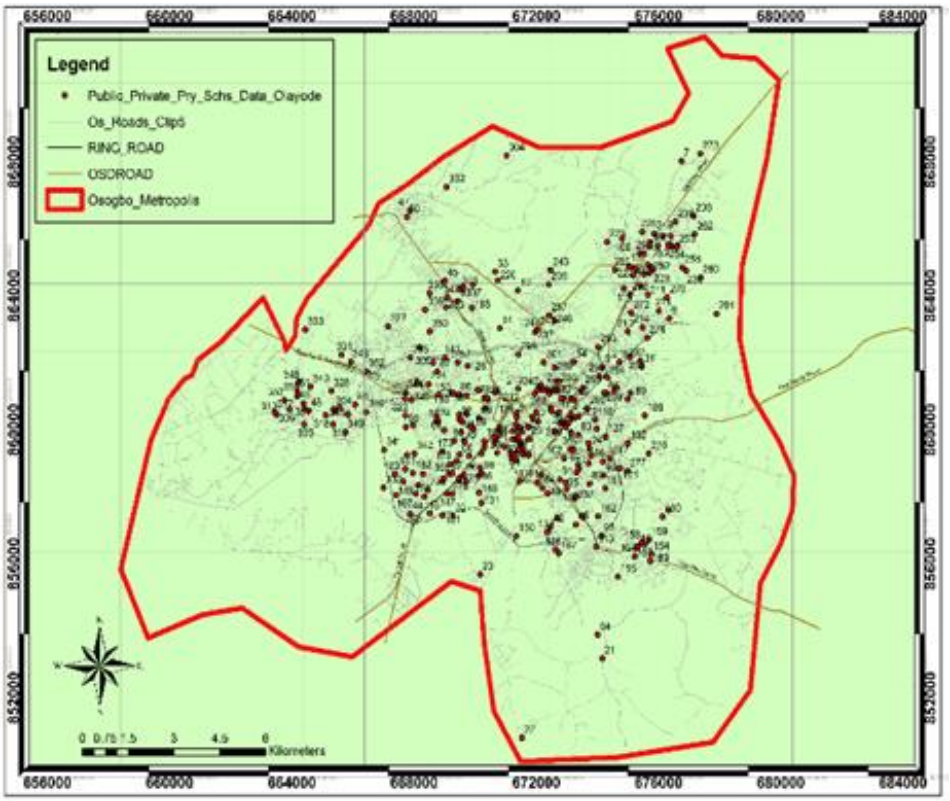
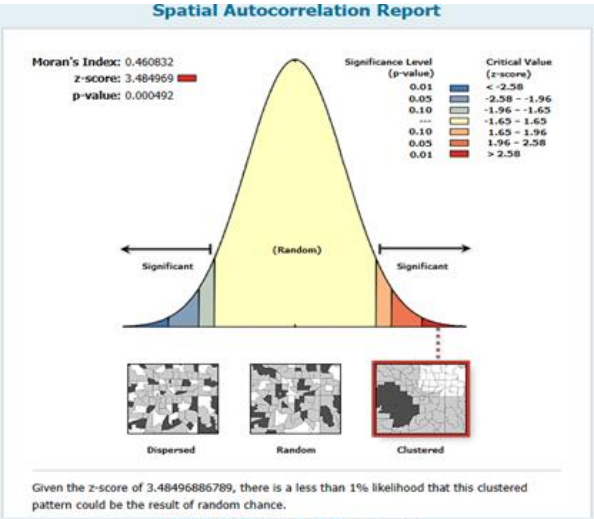


Figure 9 Spatial Location of Primary Schools in Osogbo Metropolis



Global Moran's I Summary

Moran's Index:	0.460832
Expected Index:	-0.005319
Variance:	0.017892
z-score:	3.484969
p-value:	0.000492

Dataset Information

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Input Field:	X
Conceptualization:	INVERSE_DISTANCE
Distance Method:	EUCLIDEAN
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Weights Matrix File:	None
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Figure 10 Primary Schools Spatial Autocorrelation Report

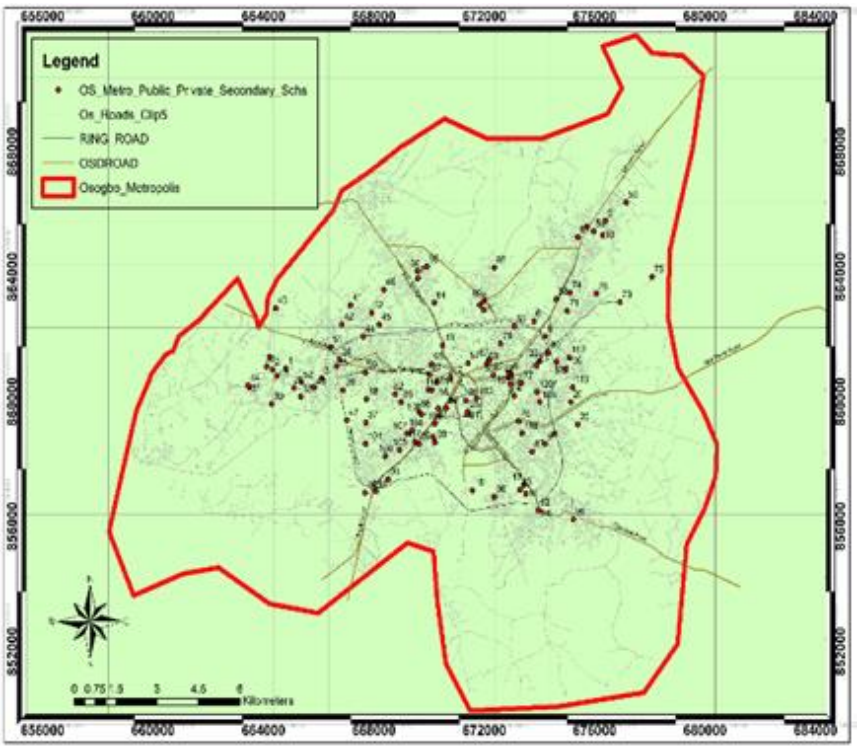

Figure 11 Spatial Location of Secondary Schools in Osogbo Metropolis

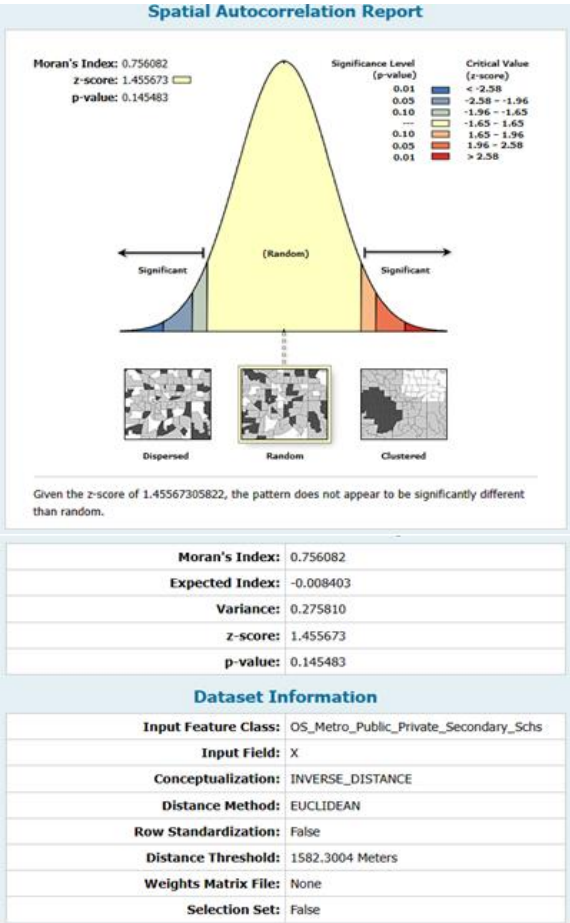

Figure 12 Secondary Schools Spatial Autocorrelation Report

The predominance of primary schools in densely populated areas of the Osogbo metropolis, as opposed to the less populated peripheries, is significantly influenced by the participation of private individuals and corporations in educational provision. Their contributions exceed governmental efforts by a ratio of 6:1. Driven by profit motives and facilitated by lax locational regulations, these entities often choose sites in populated areas, leading to a clustering effect and a threshold distance of 3.541km. This situation results in a reliance on automobiles for student transportation, counteracting sustainable neighborhood development principles that advocate for walkability and accessibility. Strategically situating educational facilities to reduce dependence on vehicles promotes environmental health by lowering traffic congestion, pollution, and accident rates.

Conversely, the distribution of secondary schools exhibits a random pattern with a threshold distance of 1.58km, reflecting the involvement of entities like religious organizations and affluent individuals capable of meeting the substantial financial requirements for establishing secondary schools. The arbitrary placement of these schools, driven by the owners' preferences rather than strategic planning, underscores the necessity for enhanced governmental regulation and planning. While the contribution of private entities in augmenting educational access is invaluable, government oversight and policy enforcement must be strengthened to ensure educational facilities are optimally located.

The data indicating that students in Osogbo metropolis travel an average distance of 5.123km to and from school daily highlights the urgency of reducing travel distances to promote sustainability and improve the educational system. Encouragingly, initiatives to achieve walkable distances to schools represent a significant stride toward creating a more sustainable and productive educational environment.

4.5 Schools as a Community Centre

The neighborhood concept, initially inspired by Ebenezer Howard's Garden City idea, was elaborated by Clarence Perry in 1929. Perry envisioned the ideal neighborhood centered around the elementary school, which served as a neutral, bias-free community hub for social interactions, including gatherings, festivities, and carnivals. This perspective views schools not only as places of learning but also as focal points for integration within the neighborhood. Emphasizing the critical role of schools in urban areas, Burgdorff (2017) highlighted education as a vital resource for urban development and renewal processes, advocating for its inclusion as a core aspect of urban development policy. The presence and quality of educational facilities are key factors that families consider when deciding where to live and seeking accessible and desirable schools for their children.

The concentration of schools in populated areas of the metropolis, as observed in the study area, and the lack of facilities on the fringes illustrate the significance of high-quality education as a major attraction for the city and each neighborhood. A neighborhood with well-equipped educational facilities tends to draw residents who can afford such amenities for their children. Radtke (2004) further argued that schools play a role in social segregation, suggesting that the distribution and quality of educational facilities can influence the socio-economic composition of neighborhoods. This underscores the importance of equitable distribution and access to quality education in urban planning and development strategies to foster inclusive and cohesive communities.

On the other hand, schools are increasingly recognized as vital agents for strengthening neighborhoods. They serve as community hubs that facilitate education and promote social cohesion by bringing together diverse groups of people. Through interaction, idea-sharing, and building robust social networks, educational facilities contribute significantly to the sense of community vital for sustainable neighborhood development. This role is especially pronounced in settings where schools remain among the few social infrastructures widely utilized by the community, as observed by Warsewa (2017) in German residential districts. Schools often become arenas for addressing conflicts and social issues, leveraging the diversity of community members to foster resolution and understanding.

Furthermore, schools play a crucial role in community development, enhancing social ties, facilitating individual social and spatial mobility, and influencing the external perception of the district. Choguill (2008) emphasized that sustainable neighborhoods require educational facilities, parks, and green spaces to serve as venues for social interaction.

In the Osogbo metropolis, and similarly in other Nigerian cities, schools are central to community life, hosting various activities from monthly meetings to weddings, funerals, cultural festivals, political events, and sports competitions. For instance, Osogbo Grammar School has become a renowned location for training workshops, government programs, and community engagements, illustrating educational institutions' multifaceted role in the city's social fabric.

However, the study reveals a disparity in the quality and quantity of educational infrastructure between the public and private sectors, with the government lagging in fulfilling its educational obligations. This inadequacy in educational facilities not only hampers the learning experience of students and staff but also diminishes the potential of schools to serve as pivotal community centers. Addressing these infrastructural gaps in the Osogbo metropolis is essential for bolstering neighborhood resilience, fostering sustainable development, and enhancing these communities' overall quality of life. Ensuring the provision of adequate and quality educational facilities represents a critical step towards achieving these goals and reinforcing the foundational role of schools in urban development and social cohesion.

5. CONCLUSION

The study found that educational facilities were inadequately available and their availability status varied significantly between schools. It also highlighted that satisfaction levels among students and staff were higher in private schools compared to public ones, indicating that private institutions are more successful in providing and managing educational facilities. This discrepancy underscores the urgent need for interventions to improve the situation in public schools. Remedial actions should focus on the renovation and sustainable provision of educational facilities to support the acquisition of necessary skills and knowledge, thereby enhancing the effectiveness of education delivery. Addressing these issues is crucial for leveling the playing field between public and private schools and ensuring equitable access to quality education for all students, regardless of the type of school they attend.

6. RECOMMENDATION

The study underscores the imperative for governmental action in addressing the deficiencies within the public educational system, particularly concerning infrastructural needs. Despite the financial constraints faced by the government in adequately funding basic education, it is essential for education to be prioritized and for governmental infrastructural commitments to public schools to be met, thereby fostering an effective education system. Social equity and inclusivity, key components of sustainable neighborhoods, demand careful attention to the location and design of educational facilities. These should aim to reduce travel distances and enhance accessibility for individuals with disabilities, a consideration notably absent in current school designs, according to the study's findings. The enhanced performance of private schools in terms of facility provision and management is significantly attributed to the oversight by relevant supervisory bodies. This monitoring ensures that these schools meet the required standards and regulations, contributing to higher satisfaction levels among their stakeholders. Extending this level of scrutiny and oversight to public schools is crucial. By ensuring that public schools adhere to the same regulatory standards as private institutions, the government can improve the quality and management of educational facilities in these schools. Implementing stringent monitoring and compliance checks for public schools will not only elevate the standard of education they provide but also ensure a more equitable and inclusive educational environment across both public and private sectors.

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LIVEABLE COMMUNITIES: A CASE STUDY OF AVAILABILITY, PROXIMITY, AND THE QUALITY OF CRITICAL INFRASTRUCTURE IN COLOMBO, SRILANKA

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ABSTRACT

The concept of livable communities has become increasingly significant in regional planning, aiming to improve the quality of life for residents. Despite continued investment in critical infrastructure in developing countries, the enhancement of livability has not kept pace with infrastructure development. This study investigates the impact of crucial infrastructure on community livability, utilizing a holistic single case study approach with Colombo as the case study. The relationship between critical infrastructure development and urban livability serves as the unit of analysis. Data were collected through semi-structured interviews with ten subject matter experts and analyzed using manual content analysis. The research finds that the availability of essential services—education, healthcare, transportation, energy, and communication—constitutes the foundation of a livable community. However, compared to its availability, inadequate attention to the quality and proximity of critical infrastructure is a fundamental reason for not achieving livability objectives in developing nations. The study identifies four aspects of proximity (residential, workplace, transportation, and emergency services) and seven aspects of quality (reliability, timeliness, safety and security, accessibility, efficiency, effectiveness, and customer satisfaction) as crucial for attaining livability standards. A key insight is the lack of consideration for community perceptions of critical infrastructure development in developing countries, hindering urban livability efforts. The study suggests Community-Driven Needs Assessment (CDNA), Participatory Budgeting, Community Infrastructure Committees, Crowdsourced Design Challenges, and Knowledge Sharing Platforms as strategies to enhance community involvement in planning critical infrastructure. It recommends further empirical research in similar contexts to evaluate the effectiveness of these approaches.

Keywords: Liveable communities; Critical infrastructure; Community engagement; Case study; Proximity

1. INTRODUCTION

The concept of sustainability has shifted from merely a buzzword to embodying a holistic approach across social, economic, and environmental dimensions, with the central aim of nurturing communities that can sustainably thrive while maintaining balance with their environment (Shao et al., 2021; Baum et al., 2022). At the heart of this evolution, "liveability" is a pivotal indicator of a community's success, ensuring residents enjoy a high quality of life marked by health, happiness, and prosperity (Waleed et al., 2023).

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The drive towards sustainable and liveable communities has become a critical focus in urban development, guiding planners, policymakers, and researchers to delve into the complex relationship between critical infrastructure and community liveability (Townsend et al., 2020). Achieving liveability requires providing the necessary infrastructure that meets the community's diverse needs.

However, cities in developing countries within the South Asian region have struggled to achieve notable positions in global liveability indexes. For instance, Karachi, Pakistan, and Dhaka, Bangladesh, are ranked among the least liveable cities despite their economic performance and infrastructure encompassing essential services like healthcare, education, transportation, water supply, energy, and communication, which are foundational to a functioning society (The Economist, 2023). Following the COVID-19 pandemic, Bangladesh reported a GDP growth of 7.2% for the fiscal year 2021–2022 (Economist Intelligence Unit [EIU], 2023), highlighting that the mere presence of such services does not automatically translate into liveability.

Similarly, Sri Lanka faces the challenge of balancing critical infrastructure development with enhancing the liveability of its people, especially in its Western Region, the most economically developed area contributing about 42% of the GDP (Central Bank of Sri Lanka [CBSL], 2018). The growth in Colombo, Sri Lanka's commercial hub, has been hampered by a decline in the quality of life, primarily due to uncontrolled urbanization, including increased vulnerability to climate change through flash floods (Hettiarchchi et al., 2014) and the inefficiencies associated with urban sprawl (Bandara & Hettiarachchi, 2010).

This study is thus framed around the research question: "How does the availability, proximity, and quality of critical infrastructure contribute to the liveability of the people living in Colombo, Sri Lanka?" It aims to explore the critical infrastructure components necessary for liveability in Colombo, identifying key infrastructure aspects and analyzing them within Colombo's context to suggest planning strategies for liveable communities.

The paper is organized to systematically address these objectives, beginning with a literature review on critical infrastructure in liveable communities, followed by the research methodology, findings, and discussion sections that aim to fulfill the study's second objective. The conclusion summarizes the key findings of the research.

2. LITERATURE REVIEW

2.1 Liveable Communities

The concept of liveability is primarily understood as a 'place-based' notion, focusing on aspects of a neighborhood or city that enhance quality of life and well-being. Liveability is geared towards short-term improvements in living standards, in contrast to sustainability, which encompasses long-term global goals to ensure future generations' well-being. The pursuit of sustainability is founded upon the three pillars of social, economic, and environmental sustainability, which align with the health, economic, and environmental dimensions of liveability (Giap et al., 2014; Tennakoon & Kulatunga, 2019; Baum, 2022).

The Department of Infrastructure and Transport Major Cities Unit (2013) adopts an evidence-based approach to city development in Australia, defining a liveable city by its health, safety, harmony, attractiveness, and affordability. This is echoed by Shamsuddin et al. (2012), who describe a liveable city as one that offers a vibrant, attractive, and secure environment for living, working, and playing, underscored by good governance, a competitive economy, high living standards, and environmental sustainability. Furthermore, Lowe et al. (2013, 2015) emphasize that a liveable community should include safety, attractiveness, social cohesion, inclusivity, and

environmental sustainability alongside affordable and diverse housing well-connected to amenities like employment, education, public spaces, and health services through convenient public transport, walking, and cycling infrastructure.

Recent studies have delved into urban development and the concept of liveable communities. Giap et al. (2014) conducted a policy simulation study to create a liveability index, while Tan et al. (2016) ranked 100 Chinese cities based on their liveability amidst rapid urbanization. Milica (2018) examined suburban development in Canberra, noting a decrease in connectivity to green spaces alongside urban development. Rojer and Hunt (2019) argue that urban development should prioritize local liveability requirements.

Cities renowned for their liveability, such as Vienna, Melbourne, and Sydney, exemplify a balanced integration of infrastructure and liveability (The Economist, 2023). Tennakoon and Kulatunga (2020) reviewed popular liveability indices. They identified six key characteristics of liveable communities: land use, housing and planning, socio-economic aspects, environment and city character, service quality and availability, service quality and proximity at the local level, and connectivity to amenities and locational attributes. These characteristics highlight the crucial role of critical infrastructure in defining a liveable community.

2.2 Critical Infrastructure

Beeferman and Wain (2016) elaborate on infrastructure as the collective of facilities, structures, equipment, or physical assets—and the entities utilizing them—that are crucial, if not indispensable, for individuals to flourish in various societal roles, fundamentally impacting their well-being and prosperity. Critical infrastructure refers to a specific segment of infrastructure that, if compromised, would significantly affect social or economic well-being (Critical Infrastructure Centre, 2017). This subset is central to forming a liveable community, as supported by urban planning literature.

ARUP (2017) categorizes critical services under "Infrastructure demand and access" in its framework for the Greater Sydney Area, highlighting these services as addressing essential human needs and core liveability challenges. Das et al. (2022) link critical services to "subjective well-being," underscoring their importance in fulfilling basic community functions. Xiao et al. (2022) identify critical services as integral to "urban construction" and "resource utilization," essential for ensuring safe, efficient mobility and access to vital amenities. Furthermore, under the smart-compact-green city model, critical services are associated with the "Mix Land Uses" principle, promoting compact, interconnected communities with easy access to essential services (Artmann et al., 2019). Thus, understanding the role of critical infrastructure in enhancing liveability is important.

2.3 Critical Infrastructure for Liveability

This research is grounded in spatial equity theory, the fundamental framework for equitable urban planning. Ashik et al. (2020) revisit the foundations of equity theory, positing that everyone should have equal access to essential resources and services, irrespective of their geographical location or socio-economic status. The concept of "Availability," articulated in this context, emphasizes that critical facilities such as healthcare, education, transportation, and utilities should be accessible to all citizens, thus promoting equitable access to opportunities (McShane & Coffey, 2022). Additionally, spatial equity entails strategically positioning opportunities to minimize accessibility disparities, ensuring no community is affected by its geographical location—this is referred to as "Proximity." Furthermore, spatial equity encompasses "Quality," advocating for uniform and high standards across different regions to guarantee that everyone enjoys the same safety, reliability, and effectiveness levels.

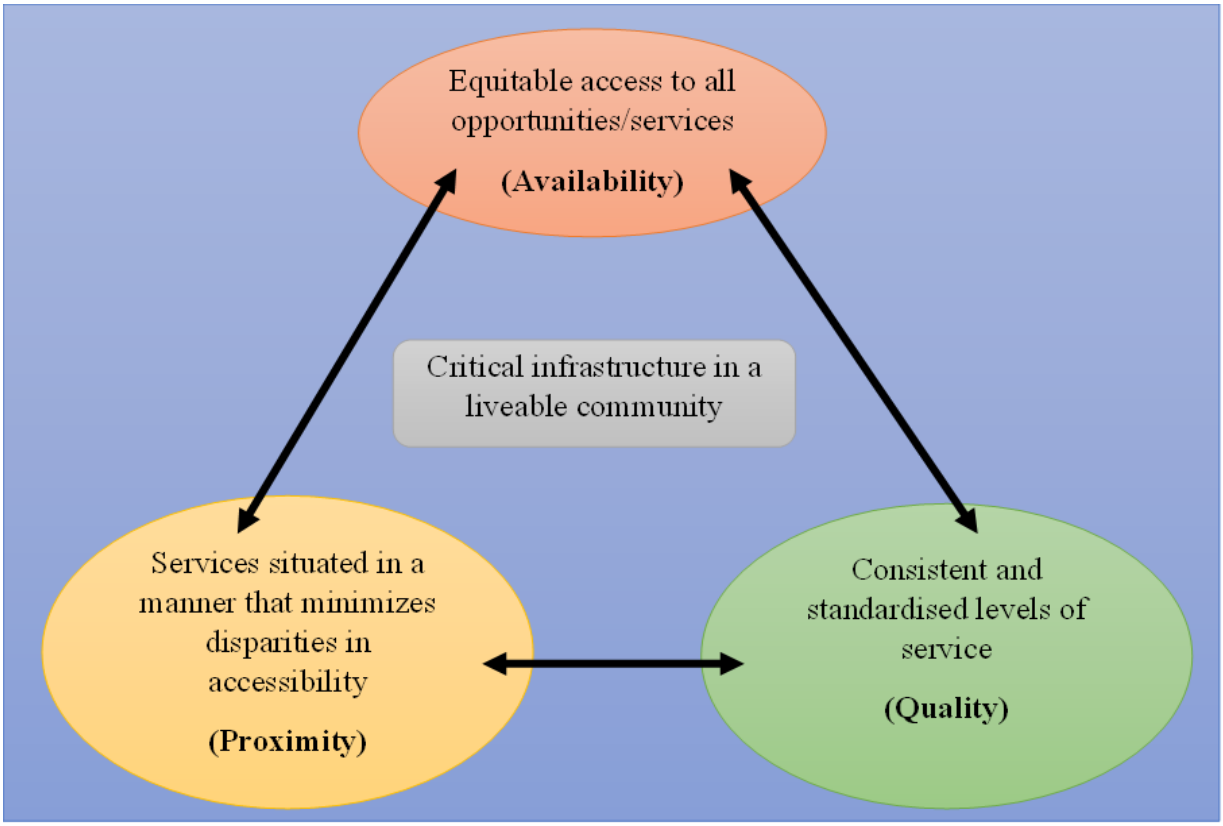

Figure 1 Aspects of Critical Infrastructure in a Liveable Community

Critical infrastructure development is crucial for fostering livable communities, yet the specific elements defining these dimensions vary based on context (McShane & Coffey, 2022). This complexity is influenced by the unique requirements of different communities, technological advancements, variations in local resources, and the regulatory landscape (McGreevy, 2018). The challenge intensifies when exploring how these dimensions interact to achieve livable communities. Studies on health equity within Australian communities suggest successful community development requires aligning critical infrastructure planning with the residents' preferences and goals (Baum et al., 2018). McGreevy et al. (2020) highlight the importance of community involvement in health and planning initiatives in Greater Adelaide. However, in developing countries, understanding the relationship between critical infrastructure and community well-being is particularly complex, influenced by changing community dynamics, variable public engagement levels, and the intricate effects of infrastructure decisions on community well-being (Bhagwath & Devadas, 2020). This research seeks to bridge the knowledge gap regarding how the availability, proximity, and quality of critical infrastructure impact the livability of Colombo, Sri Lanka's residents.

3. METHODS

Based on the core assumptions regarding the nature of scientific inquiry, various taxonomies encompass extreme philosophical positions and intermediary stances. Sexton (2003) delineates three perceptions: epistemological, axiological, and ontological, which shape research philosophy. The ontological question probes the form and essence of reality. Here, the researchers lean towards realism, perceiving individual understanding attributes as comprising a singular reality (Nind et al., 2019). Given the aim of understanding a city's liveability to enhance it or implement new regulations, idealism may not be the most suitable approach. Therefore, this study's ontological positioning resides between realism and idealism. The epistemological

question delves into the relationship between the researcher and potential readers of the study (Burrell & Morgan, 2019). In this study, knowledge about developing critical infrastructure for liveable communities is derived not from the interpretation of respondents but from the context itself, as respondents merely serve as a sample from that context. The axiological question is directly tied to the value orientation of the study, which may be either value-free or value-laden (Lewthwaite & Nind, 2016). Therefore, selecting an appropriate methodology depends on the blend of epistemology and ontology and the value added by the researcher to the study. Given that liveability is subjective and value-driven, and the researcher explores the concept from a value-laden perspective, it would be unfair to claim that the current research is value-free. Consequently, a case study strategy is employed based on the pragmatic views of the research and available theoretical propositions.

3.1 Case Study Research Method

When considering community participation in critical infrastructure development to meet the liveability requirements of Colombo's residents, it's essential to identify the unique and critical circumstances. According to Yin (2014), a single case study is appropriate for examining "critical, unusual, common, revelatory, or longitudinal cases." Moreover, Yin (2014) suggests that this strategy is suitable when the research aims to "specify a clear set of circumstances within which its propositions are believed to be true" (p.51). The selection and delineation of cases are crucial in defining a case study (Easterby-Smith et al., 2008). In this study, Colombo, the economic hub of Sri Lanka, is chosen as the case, representing a 'critical case.' This designation arises from its rapidly developing commercial capital status in a developing South Asian country. The lack of critical infrastructure to accommodate urban sprawl is a defining characteristic of this case.

Additionally, prioritizing needs over wants is imperative due to limited budgetary allocations from the government for critical infrastructure projects, a challenge shared by other rapidly developing cities in the region. Finding a similar case with comparable rates of urban sprawl and community priorities based on social and cultural values has been difficult. Thus, Colombo emerges as a critical case where its unique circumstances will help justify the propositions inferred from the findings.

3.2 Case Selection and Unit of Analysis

The case boundary for this study encompasses the Colombo Commercial City, including areas governed by the Colombo Municipal Council, Dehiwala Mount-Lavinia Municipal Council, Borelasgamuwa, Kolonnawa, Peliyagoda, Wattala – Mabola Urban Council areas, as well as parts of Wattala and Kelaniya Pradeshiya Sabha areas, as defined by the Urban Development Authority (UDA, 2019). This area has approximately 1.1 million residents and accommodates around 0.8 million daily commuters. Notably, the 2021 Budget allocated LKR 375 billion for infrastructure development, with LKR 350 billion assigned to the Ministry of Highways and LKR 25 billion to the State Ministry of Rural Roads and Other Infrastructure (Ministry of Finance, 2021). Despite substantial investments in infrastructure, Colombo struggles to rank among the top 100 liveable cities globally, sharing this challenge with cities like Karachi, Dhaka, Ahmadabad, and Chennai (EIU, 2023). These cities share characteristics such as growing economies, significant budget allocations for critical infrastructure, and ambitions to enhance liveability over the next decade. Given the study's focus on exploring how critical infrastructure contributes to urban liveability, the unit of analysis is defined as the "link between critical infrastructure development and urban liveability."

3.3 Data Collection

In the data collection process, expert interviews were chosen as the method within the case study due to the difficulty in selecting a representative sample from the population of 1.9 million

individuals for exploratory research. Expert interviews offer insights into under-explored dimensions of critical infrastructure development within liveable communities. Von Soest (2023) highlights their importance in analyzing complex decision-making processes and bridging macro and micro levels of analysis. The sampling frame comprised urban development experts with specialized experience in Sri Lanka's Western Province. Snowball sampling was employed, with experts aiding in identifying additional participants. While fifteen interviews were planned, data saturation was reached after ten interviews. Semi-structured interview guidelines were utilized to obtain relevant details while maintaining control over the interview direction.

3.4 Data Analysis

Content analysis is employed to analyze the interview data, a widely used method. According to Krippendorf (2004), content analysis encompasses various approaches, from simple word counts to thematic analysis. Thematic analysis, suitable for this study, involves identifying themes within the interview transcripts related to the research question. It utilizes pre-established categories and codes derived from the text, allowing for a mix of inductive and deductive coding (Kulatunga et al., 2007). Each free code is uniquely referenced, typically including the respondent and the direct quote from the response (e.g., RB/REF5/A3: 5th direct reference from Respondent B on availability of Transportation Service). These codes are then sorted into pre-established or newly emerged categories. While computer-aided software is an option, manual content analysis is chosen for its suitability in handling the number of transcripts and facilitating a deep understanding of the data through manual coding.

4. RESULTS

4.1 Demographic Distribution of the Respondents

The chosen experts represented various fields, including architecture and built environment, sociology, town and country planning, ecology, and economics. Initially, interviews were conducted with five experts specializing in architecture and built environment, town and country planning, sociology, and economics. Subsequently, in-depth interviews were conducted with ten experts lasting 1-2 hours. These interviews were tape-recorded and later transcribed for analysis.

Table 1 Expertise and Experience of the Experts Interviewed

Respondent	Respondens' Area of Expertise	Respondents' Experience in the Relevant Field (years)
A	Architecture and Built Environment	27
B	Urban Planning	10
C	Urban Planning	8
D	Civil Engineering	9
E	Sociology	31
F	Ecology	8
G	Economics	15

Table 1 indicates that the experts possessed a minimum of 8 years and a maximum of 31 years of experience, demonstrating expertise in both professional and academic domains within their respective fields. By including both "internal" and "external" experts—those involved in decision-making and those analyzing decisions—an integrated analytical framework was developed (Von Soest, 2023). All experts had contributed to national-level policy-making endeavors, providing a comprehensive, knowledge-based perspective. Their familiarity with the diverse viewpoints of policymakers, subjects, and users was evident, enhancing the depth of insight in the study.

4.2 Liveable Communities: Availability, Proximity, and the Quality of Infrastructure

The interview transcripts underwent meticulous scrutiny to identify critical concepts, with supportive direct quotations coded and assigned to free codes. Sub-themes related to critical services' availability, proximity, and quality were observed in the free codes and mapped accordingly.

4.2.1 Availability of Services

The notion of service availability was often reflected in the experts' responses. Under that, the types of services and the interplay between service availability and liveable communities were coded (see Figure 2).

According to Figure 2, the interviewees highlighted services such as healthcare, education, public transportation, water supply, energy, waste management, and communication networks, emphasizing the crucial role of these services for a community's overall well-being and functionality.

Consequently, most experts emphasized the importance of localism in planning infrastructure projects. For instance, respondent B stated, "Tailoring infrastructure to match the unique character of Colombo ensures it serves the public's best interests." Moreover, respondent C explained, "While the world is embracing smart cities and smart classrooms, we are still struggling to secure funds to build more schools for the underserved community in Colombo," indicating the impracticality of implementing global-level initiatives when essential local needs remain unmet. Respondent D further elaborated, "… investigating why the community resists 'park and go' concepts for the disastrous transportation infrastructure...", highlighting that the mere availability of some services is insignificant if the community does not embrace such long-tested methods with faith.

Healthcare Services (A1)

- "... holistic approach that not only builds healthcare infrastructure but also fosters public trust and understanding of available service" (RA/REF1/A1)
- "... in the eyes of the public, is influenced not only by the number of hospitals but also by the convenience of access and the quality of care" (RC/REF4/A1)
- " avalaibility of clinics, medical professionals, and emergency services in the meantime" (RF/REF3/A1)

Educational Services (A2)

- "... schools in cities should align with the urbanization rate and demographic trends to meet the needs of a growing population..." (RC/REF1/A2)
- "Public perception of higher education facilities in a particular area can significantly impact migration patterns..."(RE/REF3/A2)
- " vocational traning centers in Colombo are equality important to make the balancd skilled workforce"(RG/ REF4/A2)

Transportation Services (A3)

- "...Availability of public or private transport service around the clock changes the land prices significantly"(RA/REF2/A3)
- "... Some areas within Colombo do not have the connectivity implement a bus service at the first place"(RC/REF2/A3)
- "...Cabs are still so expensive for daily travel"(RD/REF5/A3)

Water and Sanitation Services (A4)

- "...clean water supply is pretty much established everywhere"(RD/REF2/A4)
- "... Effective water and waste management in cities is about the behaviors and choices of individuals within those cities"(RD/REF4/A4)
- "... A shift towards a circular economy mindset within the public is essential for reducing waste in par with developing the infrastructrue"(RE/REF2/A4)

Energy Services (A5)

- "... For how long are we going to depend on hydro powered electricity?"(RA/REF3/A5)
- "...Colombo cannot be solely powered using solar power"(RA/REF8/A5)
- "... renewable energy use and the related infrastrure is not developed"(RB/REF6/A5)

Communication Services (A6)

- "The exisiting communication networks are good example of privertising critical infrastrue of Colombo. It has created competition and all the advantages that follows."(RB/REF11/A6)

Figure 2 The Services that Should Have Equitable Access (Availability)

4.2.2 Proximity to Services

Four variations of proximities were identified by analyzing the responses from the case of Colombo. They were termed residential proximity, workplace proximity, transportation proximity, and emergency services proximity. Figure 3 demonstrates the evidence that enabled drawing on the four types of proximities.

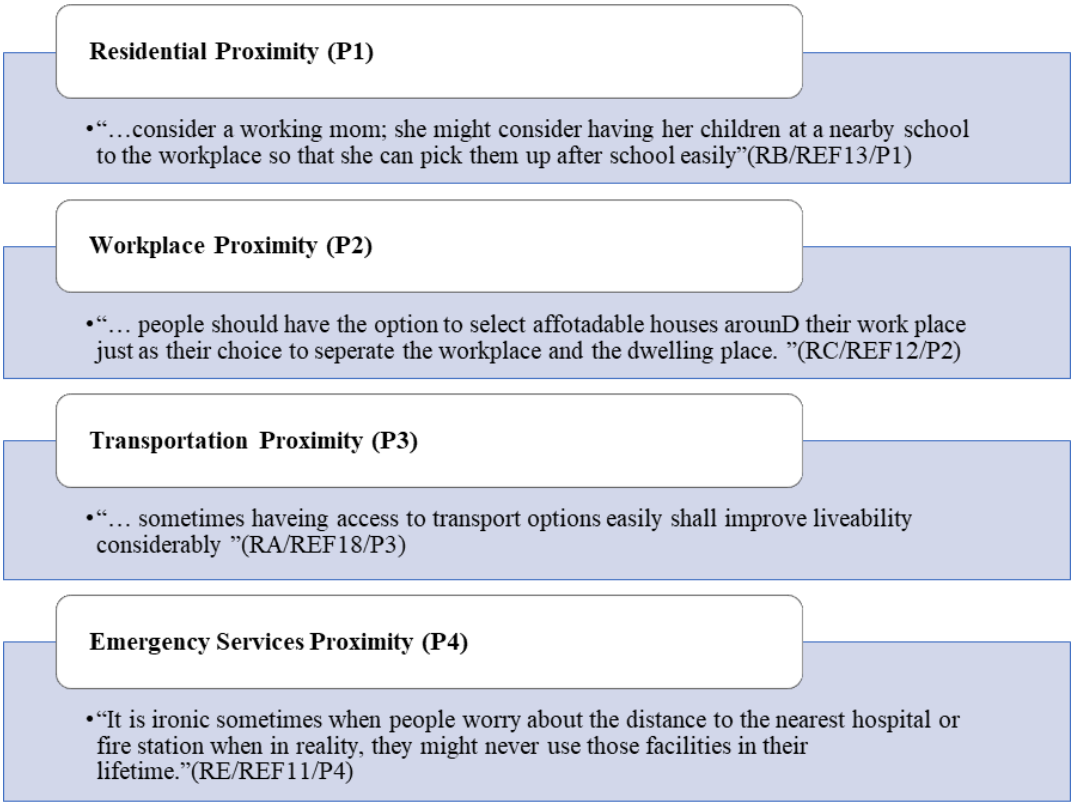

Figure 3 The Key Aspects of The Services Situated in a Manner that Minimises Disparities Accessibility (Proximity)

Interviewees A, C, D, and E highlighted the significance of residential proximity in assessing liveability, community, and satisfaction, emphasizing the importance of selecting residential areas close to essential services such as schools and healthcare facilities. However, Interviewee B presented a different perspective, suggesting that people's competitive lifestyles in suburban Colombo increasingly prioritize residential and workplace proximity for liveable conditions. Interviewee B stated, "...consider a working mom; she might consider having her children at a nearby school to the workplace so that she can pick them up after school easily." Furthermore, proximity to workplaces, transportation hubs, and amenities also plays a crucial role in determining the liveability of a community. When most of society depended on public transport modes, proximity, which indicated access to public transportation stops and transit nodes, became essential. Respondent E explained, "It is ironic sometimes when people worry about the distance to the nearest hospital or fire station when, in reality, they might never use those facilities in their lifetime." This was identified as the emergency services proximity in the framework. A shorter distance to essential services enhances convenience and reduces travel time and associated costs for individuals. Proximity was essential for services that require quick access, such as emergency healthcare or public transportation.

4.2.3 Quality of Services

The findings demonstrated key aspects of the quality of the critical infrastructure. Figure 4 exhibits the seven themes derived from the expert interviews. Respondent B stated, "… the consistency of the availability of the services is a key factor driving the people to a community, " indicating the importance of service reliability. Respondent D had a similar opinion on reliability and additionally highlighted timeliness as a measure of service quality, stating, "… there are areas with public transportation just for the namesake. You cannot be so sure of getting into a bus, let alone going on time. If so, it is your lucky day". Respondent A stated, "…our plans

prioritize making the critical infrastructure accessible for all: children and differently able people," which revealed the importance of accessibility. Poor quality services could lead to dissatisfaction, inconvenience, and potential negative impacts on health, safety, and well-being. The statement of Respondent E exemplified that "… the frequent disruptions for electricity, for example, lead to dissatisfaction, inconvenience or even safety issues when we consider health infrastructure". Hence, these dimensions and factors were interconnected, and addressing them collectively contributed to creating liveable, functional, and sustainable communities. Urban and regional planners, along with public engagement, considered these dimensions to design and implement infrastructure projects that enhanced the inhabitants' standard of living.

The expert interviews demonstrated the importance of involving the public to evaluate the quality of services in creating liveable communities with long-term goals. Respondent E expressed, "… even as a developing country, the quality of critical infrastructure (of Colombo) should be planned considering 25 years or more." Respondent C stated, "… community feedback from the municipal level is a key consideration when we develop the timely delivery of the services." Public response to these factors influenced the planning and development of critical infrastructure projects. The public often demanded accessible, high-quality services that cater to their needs. Proximity to services significantly influences the public's satisfaction with a community or city. Public input through community meetings, surveys, and consultations informed planners about local preferences and needs, helping to tailor infrastructure projects to meet public expectations.

Service Reliability (Q1)

- "… the consistency of the availability of the services is a key factor driving the people to a community" (RB/REF13/Q1)

Timeliness (Q2)

- "… there are areas with public transportation just for the namesake. You cannot be so sure of getting into a bus let alone going on time. If so, it is your lucky day"(RD/REF8/Q2)

Safety and Security (Q3)

- "… the frequent disruptions for electricity, for example, lead to dissatisfaction, inconvenience or even safety issues when we consider health infrastructure"(RE/REF3/Q3)

Accessibility (Q4)

- "…our plans prioritise making the critical infrastructure accessible for all; children and differently able people" (RA/REF5/Q4)

Efficiency (Q5)

- "... some old water lines leaks and there is no easy way to contact responsible person in an emrgncy. It is a big time now we reimplement such old services" (RC/REF9/Q5)

Effectiveness (Q6)

- "… there are areas with public transportation just for the namesake."(RD/REF8/Q6)

Customer Satisfaction (Q7)

- "... Questionable whether the public is voice is heard when improving these critical services"(RF/REF10/Q7)
- ".... quality of the services should be improved frequently from the feedback"(RA/REF16/Q7)

Figure 4 The Aspects of Consistent and Standardised Levels of Service (Quality)

Public concerns regarding environmental impact and resource conservation are also increasingly influencing infrastructure planning decisions. As awareness of environmental sustainability grows, there is a heightened emphasis on developing infrastructure solutions that are not only functional but also ecologically responsible. Policymakers can foster more resilient and adaptive communities by addressing public concerns and integrating sustainability principles into infrastructure planning. Sustainable infrastructure mitigates environmental degradation and enhances community resilience to climate change and natural disasters. Moreover, it promotes long-term economic stability by reducing resource dependency and minimizing environmental risks.

4.2.4 Community Engagements in Planning Critical Infrastructure for Liveable Communities

The respondents underscored the interconnectedness of availability, proximity, and service quality in ensuring Colombo's liveability. Interviewee E emphasized this connection by noting the limited access to healthcare facilities in certain areas outside the city, leading patients to travel to basic hospitals in Colombo. The need for comprehensive needs assessments at the community level was emphasized as a starting point to address this issue, highlighting the relationship between service availability and proximity. Similarly, Figure 5 outlines strategies for community engagement in critical infrastructure planning to enhance the city's liveability. These strategies aim to involve the community in decision-making processes related to infrastructure development, ensuring that their needs and preferences are considered.

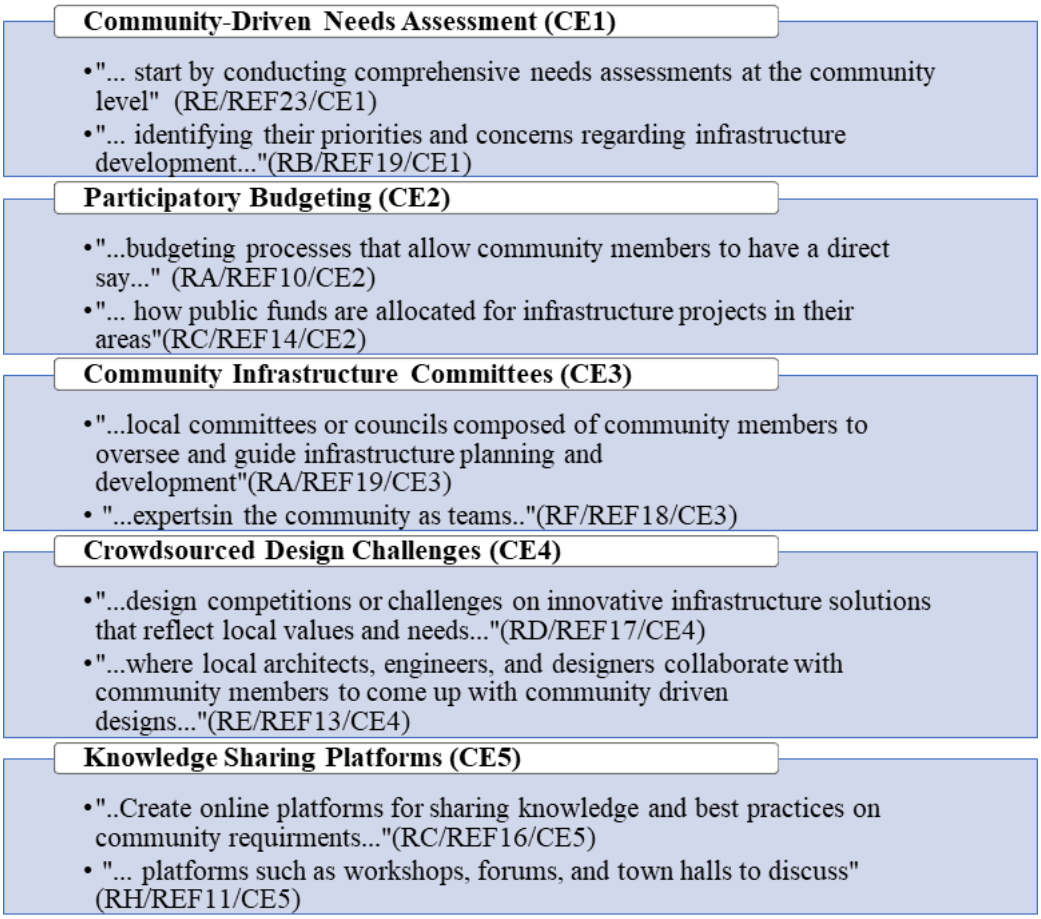

Figure 5 Ways to Ensure Community Engagement in Critical Infrastructure Development

The quality of healthcare services also impacted the overall health and well-being of the community. The first notion is identified as the “Community need assessment” (CE1) to ensure such needs were met in critical infrastructure development. A similar idea was held by respondent B, who stated, “identifying their priorities and concerns regarding infrastructure development.” Respondent A expressed, “…budgeting processes that allow community members to have a direct say..." and respondent C indicated “… how public funds are allocated for infrastructure projects in their areas". This was identified as “participatory budgeting” to test out in the critical infrastructure development in Colombo. In another instance, interviewee A asserted, “A region with inadequate public transportation services may have residents who struggle to commute to work or access other essential services”. It linked service availability, the proximity of the health care service, and the quality of transportation services, impacting people's daily lives and economic opportunities. As a measure, he recommended that “…local committees or councils composed of community members to oversee and guide infrastructure planning and development”. Interviewee C declared, “There are already established water supply and waste management services in 95% of the Colombo City Area. However, why are people questioning or complaining? I think the unreliability of water supply and poor waste management services can result in health hazards, environmental pollution, and reduced quality of life. Having these services for the sake of having them is not good enough.” The statement demonstrated the interconnectedness between service availability, the quality of services, and their broader societal implications. He proposed that it would be informative to “…Create online platforms for sharing knowledge and best practices on community requirements...”. Moreover, respondent H suggested, “… platforms such as workshops, forums, and town halls to discuss" which were offline knowledge-sharing ways to improve the livability of the society when planning infrastructure.

In summary, the interconnectedness of service availability, proximity to services, and quality of services underscored the importance of addressing these factors holistically in critical infrastructure planning. Public response and engagement were crucial in ensuring that infrastructure projects align with the needs and expectations of the communities they serve.

5. DISCUSSION

5.1 Framework to Develop Key Aspects of Critical Infrastructure for Liveability in Colombo, Srilanka

The findings highlight the components of availability, proximity, and the quality of services in Colombo, emphasizing their importance in shaping the liveability, functionality, and convenience of the community. While critical infrastructure facilities are essential for communities, the availability of services alone does not ensure liveable communities. Limited attention to factors such as reliability, timeliness, and accessibility compared to physical infrastructure development has adversely affected the liveability of Colombo.

The developed framework, depicted in Figure 6, illustrates the must-have and good-to-have components of critical infrastructure for liveable communities. Availability of services is identified as a must-have feature, while the quality of services and proximity to services are considered good-to-have critical infrastructure features. Therefore, while budget constraints may limit the consistent achievement of quality and proximity features, the framework emphasizes their importance in promoting the liveability of a community.

Quality components such as reliability, timeliness, safety, and security must be ensured within available or planned critical infrastructure to enhance the liveability of Colombo. Similarly,

proximity considerations such as residential, workplace, transport, and emergency services should be carefully addressed in critical infrastructure development to create a more liveable city.

The case study investigated the localized challenges to improve the liveability of Colombo following the example set by countries such as Australia. A key finding from the case of Colombo is that the lack of community engagement in critical infrastructure planning has resulted in reportedly low liveability despite the improvements to infrastructure. Badland et al. (2014) demonstrate how “the social determinants” have enabled Australian communities to forge their unique identities and cater to the diverse needs of their residents. This shift emphasizes the importance of understanding a community's needs, values, and aspirations when planning and implementing critical infrastructure (Boulange et al., 2017; McGreevy et al., 2020). The experts highlighted that the role of the public in the planning process has evolved from being passive recipients to active participants in the most liveable countries and not in the case of Colombo. Therefore, they proposed community engagement strategies comprehensively demonstrated in section 4.2.4 and summarized in Figure 6. The experts emphasize that public interest must be the guiding principle that planners must heed to ensure infrastructure projects align with community needs.

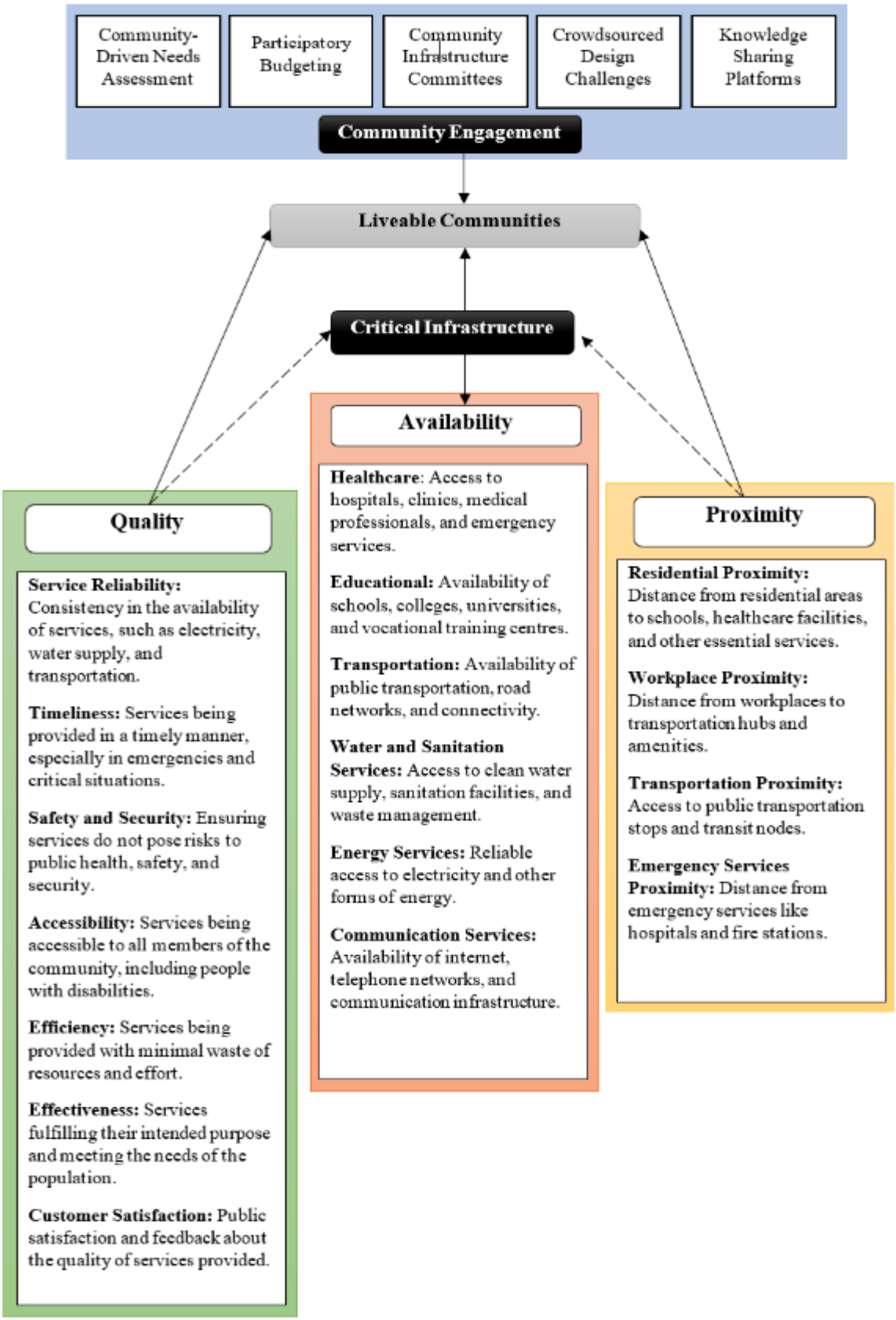

Figure 6 Framework to Develop Key Aspects of Critical Infrastructure for a Liveable City in the Case of Colombo, Srilanka

The concept leading to the development of the framework does not stray far from the Spatial Equity Theory, which aims to create fair, just, and equal opportunities within a community by addressing disparities (Ashik et al., 2020) in creating a liveable community. Similarly, in this research, community engagement in developing liveable communities is vital for the fair, just, and equal distribution of opportunities. The findings expose the lack of community-driven needs assessment, participatory budgeting, community infrastructure committees, crowdsourced design challenges, and knowledge-sharing platforms (Ashik et al., 2020).

5.2 Recommendations and Further Research Areas

The findings from the study recommend that local authorities consider three aspects — availability, quality, and proximity — when planning critical infrastructure facilities in Colombo to ensure the improved liveability of the community (Boulange et al., 2017). Further research can be conducted to develop quality assurance measures that meet international standards. Moreover, research based on geographic information systems (GIS) needs to be conducted to measure the proximity of residential, workplace, transport, and emergency services in Colombo (McGreevy et al., 2020).

Furthermore, the study recommends increased community engagement to support critical infrastructure planning (Ashik et al., 2020). Further research can be conducted by connecting the public to conduct community-driven needs assessments. The experts highlight that there is no participatory budgeting scheme in Colombo with the active involvement of the public (Boulange et al., 2017). Further research needs to be designed to increase the quality of critical infrastructure through participatory budgeting. Similarly, crowdsourced design challenges at schools and universities are recommended to extract the public perception of the liveability of Colombo and their vision for future infrastructure development (McGreevy et al., 2020).

Additionally, the current study's findings could be extended to similar scenarios. The lack of community engagement in critical infrastructure planning affects the liveability of communities in developing nations, as evident in Colombo. It shall be empirically tested for similar cases in the developing nations of the South Asian region. In the case of Colombo, the experts suggest that community engagement can be encouraged through community-driven needs assessment, participatory budgeting, community infrastructure committees, crowdsourced design challenges, and knowledge-sharing platforms (Ashik et al., 2020; McGreevy et al., 2020). Australia uses similar “collaborative planning” approaches at the state level, where individual community needs are actively considered. Therefore, the findings of the current study, coupled with the experiences of similar cases, shall be collectively used to design similar research to suit individual cases in cities with low liveability rankings (Badland et al., 2014).

6. CONCLUSION

The study aimed to investigate the critical infrastructure components necessary to enhance the liveability of Colombo, Sri Lanka. Employing a case study research strategy, the city of Colombo served as the boundary for the investigation, with ten experts intimately involved in Colombo's urban development, providing insights through interviews. The findings illuminated the intricate relationship between availability, proximity, and quality of critical infrastructure, showcasing their role in fostering spatial equity within the city.

As articulated by the respondents, availability encompasses six crucial services — healthcare, education, transportation, water and sanitation, energy, and communication — essential for Colombo's seamless functioning. While transportation infrastructure often takes precedence in developing cities like Colombo, the study emphasizes the equal importance of all these services to enhance liveability.

Proximity to essential services is the conduit that transforms availability into utility, bridging the gap between infrastructure and community needs. Moreover, service quality extends beyond mere efficiency, encompassing reliability, timeliness, and satisfaction, significantly impacting community vitality.

A key research finding is the lack of community engagement in critical infrastructure development, leading to unmet liveability requirements. In many developing countries, public voices often echo demands for accessible, high-quality services aligned with their needs. The study recommends strategies like community-driven needs assessment, participatory budgeting, community infrastructure committees, crowdsourced design challenges, and knowledge-sharing platforms to address this. These approaches ensure that critical infrastructure development aligns with the community's availability, proximity, and quality requirements.

The proposed framework infuses local insights and perceptions by incorporating community input gathered through engagement processes, ensuring that infrastructure resonates with community aspirations. Further research is warranted to delve deeper into the availability, proximity, and quality of critical infrastructure and explore the efficacy of the recommended strategies in enhancing liveability.

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AN ARCHITECTURAL APPROACH TO NEIGHBOURHOOD DESIGN IN THE QUARRY ROAD INFORMAL SETTLEMENT IN DURBAN

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ABSTRACT

Informal settlements, often characterized by inadequate infrastructure, housing, and services, are a significant urban challenge in the global South. Creating well-functioning and supportive neighborhoods within these settlements is crucial for improving the living conditions and livelihoods of those living there. This paper explores the strategies and principles of creating neighborhoods in informal settlements that promote community empowerment, social cohesion, and sustainable development. Conventional top-down development approaches often fail to address these settlements' unique needs and dynamics. In contrast, a bottom-up approach empowers residents, fosters community engagement, and promotes sustainable development. This paper explores how architecture can respond to the needs of informal dwellers and be used as a tool to empower them. Synthesizing architecture and informality through an understanding of the existing socio-spatial dynamics, culture, economic networks, insurgent practices, and approach to the production of the built form of informal settlement communities can produce a more responsive architecture capable of increasing informal settlement communities' resilience to site-specific challenges, improving their quality of life, and ultimately aiding them towards their hopes and aspirations. The theoretical framework combines the concepts of Culture, Insurgency, and the "Right to the City." The methodology included data collection using a combination of spatial mapping, observations, transect walks, and focused group interviews. The findings revealed the dynamics of the settlements, which could only be mapped and understood from firsthand experience of walking and learning from the community. The communities' needs and threats were mapped. This formed the basis for an architectural approach to stitch and create sustainable neighborhood design.

Keywords: Sustainability; Insurgency; African cities; Circular economies; Resilient cities

1. INTRODUCTION

South African cities have been profoundly influenced by two major ideologies: modernism and apartheid, both of which have shaped the urban landscape into contested, controlled, and surveilled spaces built on principles of exclusion and segregation (Claasen, 2014). The apartheid model specifically marginalized people of color from urban centers, leading to their occupation of leftover spaces on the outskirts of towns as they became integrated into the labor force and established social and economic ties within cities.

Nearly three decades after the dismantling of apartheid, informal settlements have increased on the fringes of Durban city, with their growth remaining unchecked by authorities. The urban poor have seized upon the leftover and underutilized spaces surrounding the city fringes in their quest to access and assert their right to the city.

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These leftover spaces inhabited by informal settlement communities pose significant hazards to their health and well-being. Exposed to the elements, such as flooding and soil erosion, these communities face increased risks due to their precarious living conditions. Additionally, their reliance on fire for heating and cooking, coupled with a lack of electricity infrastructure, heightens the threat of fire hazards, particularly given the settlements' density and the materials used in construction. Furthermore, inadequate access to essential services, such as sanitation, clean water, and waste disposal, exacerbates the risk of disease transmission.

The absence of social infrastructure and public space in informal settlements can be attributed to municipal constraints in investing in contested lands occupied by these settlements. Often situated on unsuitable terrain prone to flooding or soil erosion, these settlements resort to costly building practices to mitigate safety concerns, resulting in densification at the expense of public space.

Efforts by authorities to address the challenges faced by informal settlement communities often employ a top-down approach that overlooks the communities' real needs and lifestyle practices. Consequently, interventions fail to adequately address the complexity of these environments or the residents' requirements.

Consequently, informal settlement communities endure ongoing hostility, displacement threats, and a lack of recognition, hindering their progress toward their aspirations (Hutchzermeyer, 2011). Residents persist in inhabiting unsuitable environments, confronting climate change threats and eviction risks, necessitating more responsive design interventions grounded in the informality culture.

This paper hypothesizes that a synthesis of architecture and informality, informed by understanding socio-spatial dynamics, culture, economic networks, insurgent practices, and built form production within informal settlement communities, can yield a more responsive architecture. Such an approach could bolster their resilience to site-specific challenges, enhance their quality of life, and advance their aspirations.

The paper delves into how informality, coupled with the culture and insurgent practices of informal settlement communities, can inform an architectural approach to neighborhood design that addresses the challenges faced by these communities.

2. LITERATURE STUDY

2.1 Socio-Cultural Identity: Its Influence on Placemaking and Built Form

Stea and Turan (in Kellet & Napier, 1995) emphasize the role of communities and participation when describing place production. Their study frames informal settlements as a contemporary vernacular born from a globalizing world and a capitalist economy. They claim that these communities worldwide have similar approaches to the production of place and built form, which they refer to as their "Mode of Production." This is then influenced by a society's "Conditions of Existence," which can be distinguished as Cultural or Material Conditions.

2.1.1 Cultural Living Conditions

According to Dube (2015), informal settlements have historically been associated with rural-urban migrants. Approximately half of the residents in Durban's informal settlements are from townships, while the remaining population is mainly comprised of more recent immigrants from rural areas (Cross et al., 1994 & Kellet et al., 1995)

The migrants who've moved to the urban centers are often said to live in two different worlds. Simmel (in Alsayyad, 2004) states that they manifest cultural hybridity, carrying the culture they inherit from their rural background and the more globalized culture associated with urbanism.

This cultural hybridity is evident in informal settlements' strong sense of community. While the capitalist, neoliberal aspects of the more globalized culture of urbanity encourage individuality and even competitiveness, rural and township cultures tend to display a more vital awareness of mutualism and community (Lloyd, 1979). There is an understanding from informal settlement communities that cooperation is necessary to overcome the constant challenges of their living environment. Hence, while their aspirations may be inspired by individual achievement characterized by urbanity, their working method is mutualism.

Fischer (1976), referencing an American study, writes that the tendency of a person in an urban setting to know more than twenty of their neighbors is rare. In an informal settlement, Perlman's (1976) study showed that the community was much more closely bonded through their shared struggles and hardships.

In addition to pre-existing relationships, new ones are easily forged in these environments. Subcultural theory posits that adverse living conditions and environments foster community formation for mutual support. Relationships and social bonds in informal settlements manifest on three levels. The broadest level pertains to the entire settlement community. The second type, primary groups, forms through kinship, ethnicity, and friendship bonds, often as a gateway to the settlement. The third type, secondary groups or subcultures, emerges through shared activities, class, occupation, or interests (Fischer, 1976).

This phenomenon is evident in the Quarry Road West Informal Settlement in Durban through various community activities. Church groups, waste pickers, and women in the settlement organizing daycare services for children showcase the diverse social fabric within the community. Men gathering at local establishments like shebeens and shisa-nyama to watch soccer matches and children playing in open spaces further illustrate this vibrant community life. Daily tasks like communal washing lines or collecting water from municipal standpipes also contribute to the communal dynamics.

These subcultures foster a sense of solidarity among residents, uniting them in their shared struggles. The community adopts participatory systems wherein leadership roles are assigned based on individuals' skills and knowledge to address everyday challenges effectively. In such conditions, informal settlements become hubs of creativity, where residents devise innovative solutions to overcome obstacles. They reclaim communal spaces for various purposes, foster collaboration and cooperation, and cultivate a strong sense of community characterized by social exchange and cultural richness (Hutchzermeyer, 2011). Figures 1-3 illustrate the communal spaces.

Figure 1Typical Roadside Shisa-Nyama, which Acts as a Meeting Point for Groups People in the Settlements (Source: Plaas, 2023)

Figure 2 Shows how Children and Teenagers Make Use of Open Public Space in Settlements to Play Sports (Source: The Guardian, 2014)

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2.1.2 Material Living Condition

The material living conditions experienced by informal settlement communities are marked by constant uncertainty stemming from the persistent threat of evictions, natural disasters, and disease outbreaks. Economic challenges further exacerbate their plight, with many residents facing unemployment, precarious employment, or insufficient wages to meet their basic needs (Shaikjee, 2018). Others rely on small-scale businesses to make ends meet. In such contexts, adaptability becomes a necessary survival strategy.

As noted by Mehrotra (2010), the physical environment of informal settlements is in a state of continual flux, constantly evolving in response to the complex interplay of physical, social, political, and economic factors.

Figure 3 Settlements are Constantly Threatened by Natural Disasters or Fear of Eviction (Source: Author)

2.1.3 Modes of Production the Construction of Informal Settlements

The volatile and uncertain living conditions experienced in informal settlements drive a mode of production characterized by adaptation. The built environment and urban fabric continuously evolve to meet the changing needs of residents and the challenging conditions they face. Kellett and Napier (1995) describe this ongoing construction and transformation of space by residents as a process of "consolidation," which manifests in varying degrees across different settlements in response to diverse physical, social, cultural, economic, and political factors.

Kellett (1995) illustrates the influence of the family unit on consolidation levels by contrasting two informal settlements in Columbia. In Santandareano, where the family unit holds cultural significance and is closely tied to the church, dwellings, and urban spaces exhibit higher levels of consolidation. Conversely, in Samario, where the cultural significance of marriage is less pronounced and single mothers predominate, households struggle to establish complete homes and shape their urban environment accordingly.

Household income also significantly affects the degree of consolidation. Klaufus (2000) observes that settled residents with stable employment tend to have more consolidated dwellings and spaces, whereas newer residents often inhabit more temporary structures.

In South Africa, socio-political factors exert a substantial influence on consolidation levels. Historical policies promoting slum eradication and eviction of informal settlement residents, driven by urban competitiveness (Hutchzermeyer, 2011), have led to lower levels of consolidation in settlements. Fear of eviction discourages residents from investing significant resources in dwellings they may lose. In Durban, many residents have faced the threat of relocation without any action by authorities (Shaikjee, 2018).

Another significant factor in Durban is the prevalence of rental households, particularly among female-led households, within informal settlements. Consolidating dwellings or shaping the surrounding space is not a priority for these renters. Figure 4 shows the level of consolidation of dwelling in the Savda Ghevra informal settlement in India

Figure 4 Levels of Consolidation of Dwelling in the Savda Ghevra Informal Settlement in India (Source: King, 2017)

2.1.4 Spatial Relationships within the Settlement

A common characteristic observed in informal settlements worldwide is high population density, driven by the large number of residents and the limited availability of land. Additionally, the lack of planning control creates densely populated living environments that challenge conventional public and private space allocation notions.

A study conducted in Mexico by Elena Tames (2004), comparing two informal settlements with two formal housing projects, clearly emphasizes private space within informal settlements. In these settlements, private areas occupied 54% and 63% of the land, whereas they accounted for only 29% and 26% of the formal housing projects. Tames (2004) noted that due to land scarcity, streets served as de facto public spaces without formal squares. Furthermore, the absence of formal planning led to streets being unevenly encroached upon by porches and buildings. Figure 5 illustrates an example of a street in an informal settlement, highlighting public spaces forming in wider portions of the street and demonstrating the gradation of privacy with semi-private zones shaded in. Meanwhile, Figure 6 depicts a public space along a path marked by the position of a tree in the Quarry Road West Informal Settlement.

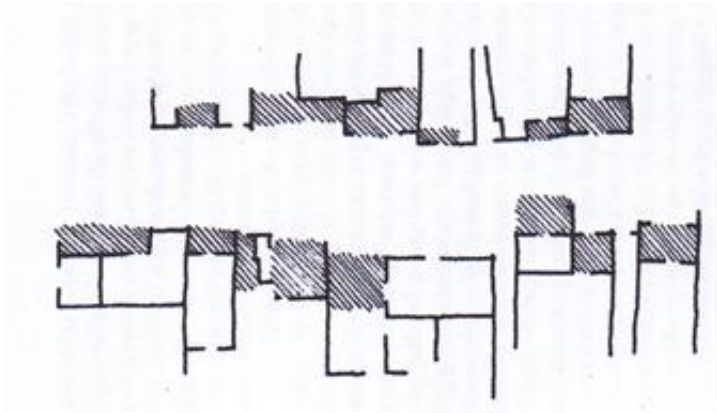

Figure 5 An Example of a Street in an Informal Settlement, Showing Public Spaces Forming in Wider Portions of the Street and the Gradation of Privacy with Semi-Private Zones Shaded in. (Source: Opalach, 1997)

Figure 6 A Public Space along a Path Marked by the Position of a Tree in the Quarry Road West Informal Settlement
(Source: Author)

In Durban's informal settlements, dwellings along main pathways often serve multiple functions, such as shebeens, spaza and tuck shops, food stalls, and teenage game rooms (Shaikjee, 2018). The areas outside these home-based enterprises are hubs of activity and social interaction. Due to the prioritization of private space and the efficient use of available space, public spaces are often multifunctional – for example, daycares or shops that convert into dwellings or roads that serve as recreational areas for youth during quieter times. Utilitarian spaces like water collection points, toilets, and clotheslines also serve as valuable public spaces, as their functionality prevents encroachment by private dwellings.

2.1.5 Levels of Privacy

Privacy within informal settlements is primarily managed through social connections, particularly kinship ties. Tames (2004) highlights the prevalence of plot sharing in Mexican informal settlements, with a clear distinction between family members and friends or neighbors. Similarly, observations by Klaufus (2000) in Ecuador reveal that the interior of dwellings is typically reserved for family members, while social interactions with friends, neighbors, and acquaintances occur outside the home.

In Sao Paulo's informal settlements, Opalach (1997) observed the presence of buffer zones between highly private dwellings and public streets or pathways. These buffer zones often form semi-private spaces, utilizing semi-transparent screens to shield entrances from the street. The level of privacy within Sao Paulo's informal settlements varies depending on factors such as the degree of consolidation of the dwelling and the family's economic status. Permanent and consolidated dwellings typically enjoy higher levels of privacy from the street than more temporary structures. Figure 7 displays a semi-private zone along a path in the form of a covered veranda in the Quarry Road West Informal Settlement. Figure 8 illustrates an example of family plot sharing in an informal settlement in Mexico.

Figure 7 A Semi-Private Zone along a Path in the form of a Covered Veranda in the Quarry Road West Informal Settlement
(Source: Author)

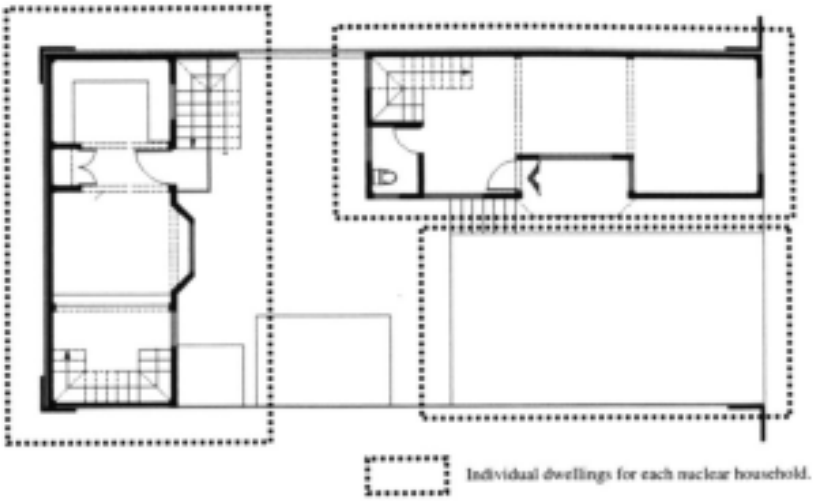

Figure 8 An Example of Family Plot Sharing in an Informal Settlement in Mexico
(Source: Tames, 2004)

2.2 Insurgency as an Architectural Response to Informality

2.2.1 Insurgent Spaces

"The Right to the City," penned by Henri Lefebvre in the 1960s, emerged as a response to European cities succumbing to capitalistic planning that prioritized consumption over traditional communal values (Harvey, 2012). Harvey emphasizes that the right to the city entails having a voice in shaping urban environments and influencing how cities evolve and transform.

Informal settlement communities assert their right to the city by confronting oppression across three dimensions. Firstly, they advocate for the town's right to long-term habitation and spatial

centrality. Secondly, they demand the right to participate in central decision-making processes. Lastly, they strive for the right to shape public space (Hutchzermeyer, 2011) creatively.

Lindsay Bremner and Philip De Boek (in Bremner, 2010) illustrate how informal settlement dwellers exhibit remarkable adaptability and flexibility. De Boek notes that signage is the sole material requirement to restrict space in a Kinshasa informal settlement, leading Bremner to coin the term "invisible architecture," as the infrastructure is defined more by its absence than its presence. This approach to space fosters dynamic urban environments conducive to continual change and accommodating diverse activities. Rem Koolhaas (in Bremner, 2010) characterizes such spaces in Lagos as "flex-scape," describing them as adaptable, all-encompassing, flexible, and capable of transforming as needed. Bremner observes similar dynamics in Kliptown, South Africa, where a soccer pitch transitions seamlessly into a church, motor repair shop, or street, and living rooms serve multiple purposes as shops, meeting spaces, or youth clubs.

2.2.2 Synthesizing Insurgency & Architecture

Insurgent practices manifest as actions undertaken by marginalized groups through extra-legal means to assert their rights to the city, encompassing rights to housing, urban habitation, creative control over public and private spaces, and involvement in decision-making regarding urban areas (Shaikjee, 2018). The act of occupying and constructing informally within vacant spaces in and around cities represents an inherent insurgent practice, as these groups seek to reclaim space and assert the rights that have been denied to them.

To effectively address the challenges faced by informal settlement dwellers and their insurgent practices, architects must actively engage the affected communities in conceptualizing solutions to their daily struggles. Sandercock (1998) contends that achieving social justice necessitates architects' willingness to listen to diverse voices and embrace a politics of difference.

Architects and the formal sector must prioritize inclusivity and actively incorporate the perspectives of marginalized communities, which offer unique insights and concerns that conventional approaches may overlook. These marginalized spaces foster novel and inclusive modes of thinking, as well as alternative knowledge transmission methods such as storytelling and oral tradition, which often diverge from conventional theoretical frameworks (Sandercock, 1998).

Valuing the lived experiences of informal settlement communities is paramount in conceptualizing meaningful responses to their challenges, as emphasized by Anzaldua (in Sandercock, 1998). Elleh (2011) further underscores the importance of architects describing informal settlement neighborhoods using the vernacular of the local context, bridging the gap between formal and informal realms and acknowledging the lived realities of these communities.

2.2.3 An Architectural Approach to Informality

An architectural approach to informality necessitates a keen awareness of the urgent context within such environments. These spaces are highly vulnerable to risks, including inclement weather, flooding, fires from illegal electricity connections, and severe health hazards due to inadequate access to clean water, sanitation, and waste removal. Therefore, architects must understand the community's prioritized issues to assist them in averting potential catastrophes and design solutions accordingly (Brillembourg and Klumpner, 2011).

Brillembourg and Klumpner (2011) assert that informal settlements embody a context of constant uncertainty, where social, economic, physical, and political circumstances are perpetually at risk of change. Consequently, architects' responses must be adaptable and capable of absorbing and accommodating such fluctuations. This requires architects to engage in unconventional

approaches, including research, networking, community mapping, and participatory building processes.

In response to the challenges of informal settlements and insurgent spaces, architects must develop an architecture that integrates the inherent knowledge systems of these communities into its design principles. As Sandercock, Holston, Anzaldua, and Elleh suggested, this architecture should prioritize adaptation and flexibility, empowering users to creatively shape and reshape their environment in response to ongoing changes and challenges (Shaikjee, 2018). It should mitigate the harsh realities of the informal context while aligning with the priorities of informal settlement communities.

3. METHODOLOGY

The case study focuses on the Quarry Road West Settlement in Durban, which has existed since 1984. Situated on the southern side of the M19 highway, on the floodplain of the Palmiet River, 1.7 km before it joins the Umgeni River, this settlement is a pertinent example for examining architectural interventions through a bottom-up approach (see Figure 9). While this case study has been extensively researched, it offers a unique perspective by approaching it from the lens of architecture. The study employed various data-gathering methods, including collaborative mapping processes and transect walks:

The collaborative mapping process is a process that by utilizing drones, the study generated live data to create maps that form the basis for collaboration (see Figure 10). Unlike Google Earth and satellite imagery, which are often outdated, drone imagery provides real-time data crucial for capturing the dynamic nature of informal settlements. These maps helped sketch the community's daily practices, livelihoods, threats, and risks (Govender & Loggia, 2017; Loggia & Govender, 2020).

Meanwhile, transect walks involve immersing the community perspective to understand the site's inner workings (see Figure 11). Through observation, photographic analysis, and informal discussions with community members, the researchers aimed to understand the settlement's fabric (Govender & Loggia, 2017; Loggia & Govender, 2020).

Figure 9 Annotated Drone Map of the Quarry Road West Informal Settlement

Figure 10 Community Workshop Using the Drone Maps as a Base for Discussion

Figure 11 Transect Walk-through Settlement

These primary research methods were guided by the theory presented in this document, emphasizing interaction and engagement with the community. By involving the community in the research process, the study sought to allow them to shape the proposed architectural interventions based on their intimate knowledge of the environment. The underlying premise of the research is that meaningful engagement with informal settlement communities is essential for architects to develop responsive architecture tailored to their needs.

4. RESULTS AND DISCUSSION

4.1 Findings & Discussion

Through transect walks and community collaborative mapping, precise settlement maps were generated using drone imagery. The data collected encompassed various activities and their locations, providing insight into the central social nodes within the settlement and identifying hazards present in the area.

The resulting maps demonstrated, consistent with existing literature, that most significant activities within the settlement occurred along pathways. These bustling paths extended beyond the settlement's periphery and permeated its interior, hosting establishments such as shebeens, community halls, churches, daycare centers, retail outlets, and meeting spots. A section of the settlement in the southwest had experienced a fire incident, leading to the displacement of many residents. Emergency housing, comprising corrugated iron dwellings, was provided by the municipality. Notably, the topographical analysis revealed a distinct lack of organic development in this area compared to the rest of the settlement. The paths here followed rigid, linear patterns without variation, reflecting a departure from the typical organic growth observed elsewhere. In contrast, areas, where spaces developed organically through residents' construction efforts exhibited features reminiscent of squares, albeit on a smaller scale. These communal squares or courtyards, shared among several houses, served as focal points for community interaction and activities such as accessing communal amenities like standpipes clotheslines, or attending religious gatherings.

Where spaces evolved organically through residents constructing their environment, one can discern the emergence of squares within less public areas. These small public squares or courtyards are shared by a few houses, serving as communal gathering spots. In some instances, they manifest as a cluster of dwellings opening onto a shared space, while in others, they arise around specific activities, such as communal standpipes, clotheslines, or churches (see Figure 12).

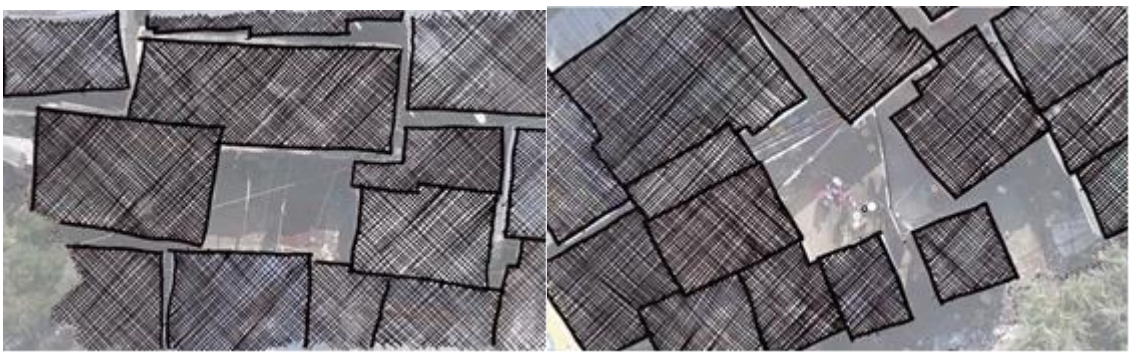

Figure 12 Small Courtyards that Formed around Areas of Activity within the Settlement. Examples are the Communal Water Standpipe and the Clothes Lines

The data collected to map hazards revealed significant issues within the settlement. One major hazard identified was the dumping of refuse. With the settlement accommodating a dense population and lacking formal waste disposal methods, many residents resorted to dumping waste in the river. Consequently, the riverbanks became heavily polluted, serving as breeding grounds for rats and contributing to an unhealthy environment. Another notable hazard is the river itself, which divides the settlement. Instances of drownings have occurred as residents cross shallow parts of the river daily. Additionally, buildings too close to the river's edge risk flooding.

Figure 13 depicts a sketch plan of the Quarry Road Settlement, illustrating the spaces of activity within the settlement produced from the community collaborative mapping exercise. Meanwhile, Figure 14 showcases the pedestrian paths and social nodes produced from the community collaborative mapping exercise.

Figure 13 A Sketch Plan of the Quarry Road Settlement Showing the Spaces of Activity within the Settlement Produced from the Community Collaborative Mapping Exercise

Figure 14 The Pedestrian Paths and Social Nodes Produced from the Community Collaborative Mapping Exercise

4.2 Architectural Approach & Intervention

The literature presented in this paper advocates for an architectural approach within informal settlements that is deeply informed by informality and the culture of informal settlement communities. This approach necessitates a thorough study of the community and its settlement. The response derived from the gathered data has enabled the hypothesis of an architectural intervention: a Resilience Hub for the Quarry Road West informal settlement community. This intervention addresses and alleviates the community's daily site-specific challenges, ultimately enhancing their quality of life.

The design intervention aims to utilize architecture to transform the inaccessible spaces within the dense fabric of the settlement and integrate them back into the surrounding informal fabric. It comprises strategically placed buildings throughout the settlement, positioned along existing paths and nodes to incorporate the informal settlement fabric seamlessly. Additionally, the proposed urban design includes incremental upgrading facilitated by the Resilience Hub, gradually transforming the entire settlement from its inception (Shaikjee, 2018). The design features a central Resilience Hub and Resilience Pods distributed throughout the settlement.

4.2.1 Concepts

Stitching into the Informal: Integrating seamlessly into the informal urban fabric enhances resilience and empowers the community towards their aspirations (Shaikjee, 2018).

Weaving into the Informal Fabric: By identifying existing paths, nodes, social spaces, risk areas, challenges, and socio-political circumstances and embedding architecture within this system, integration into the informal fabric is facilitated (Shaikjee, 2018).

Flexibility & Incrementalism: Given the user-driven nature of informal settlement architecture, which is dynamic and adaptable, architectural responses must be flexible and incrementally planned to meet evolving needs and priorities (Shaikjee, 2018).

Reflecting the Informal: To embrace the distinct character of the informal fabric, architecture should be situated within this context and reflect the local identity, thus resonating with the informal environment (Shaikjee, 2018).

4.2.2 Stitching the Footprint into the Informal Fabric

The data gathered from the maps illustrated the locations of existing paths within the settlement. Neighborhood design utilized these paths to strategically position the Resilience Pods and the Resilience Hub. The Resilience Hub and Pods were tools for integrating the settlement, particularly across the river, a significant division. The proposed Hub, situated on private land within the settlement, aims to leverage this space to reunite the four parts of the settlement (see Figure 15).

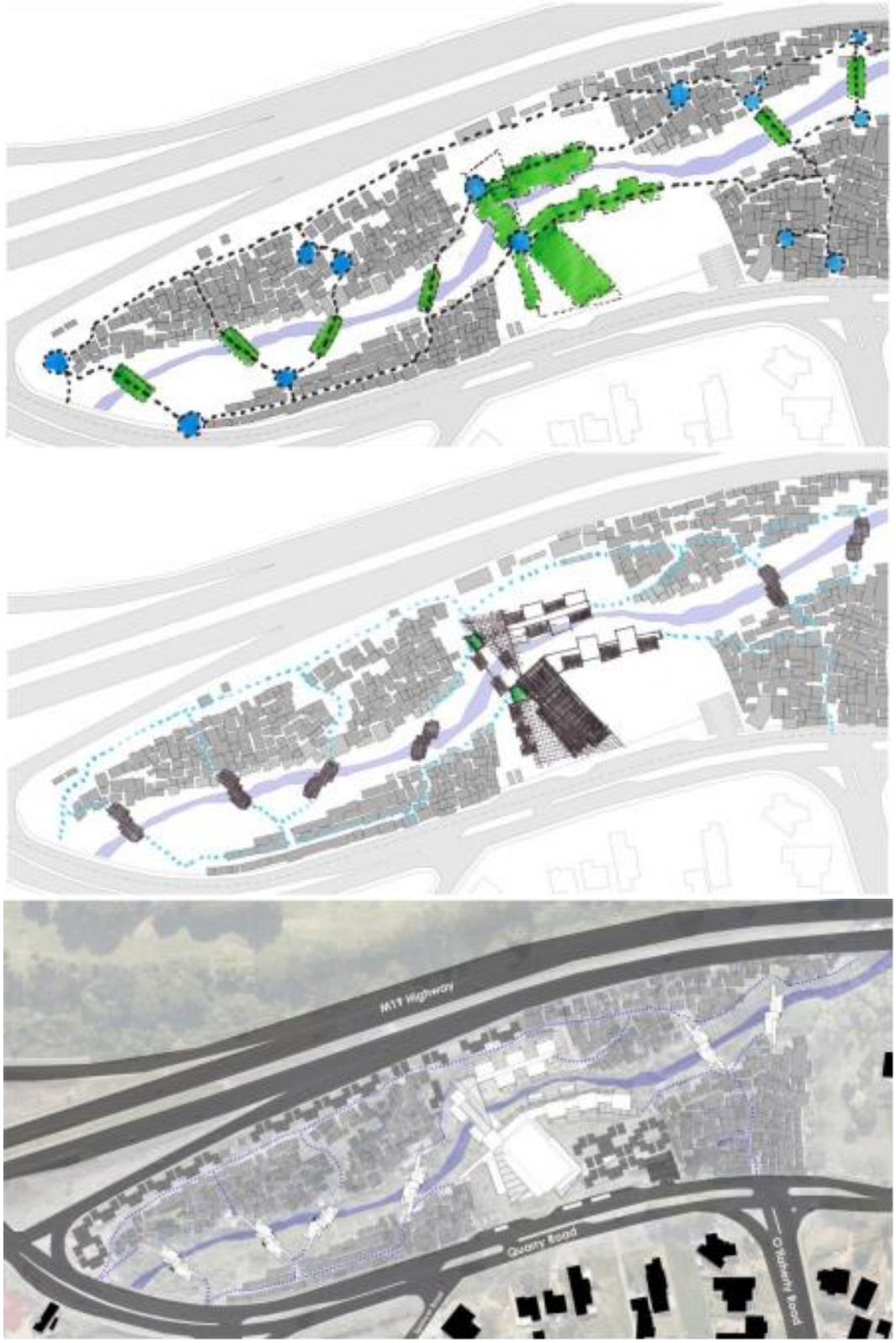

Figure 15 Development of the Urban Design and Building Footprints from Collected Path Data

4.2.3 Planning & Incremental Design

Considering the volatile physical context of informal settlements and the community's changing needs in response to it, the design was intended to be implemented incrementally. This approach allows for the prioritization of the most urgent aspects and enables the community to have a say in the order of incremental phasing as needs arise and change.

a) Phase 1

Phase 1 involved data collection, community engagement & co-design, as shown in Figure 16.

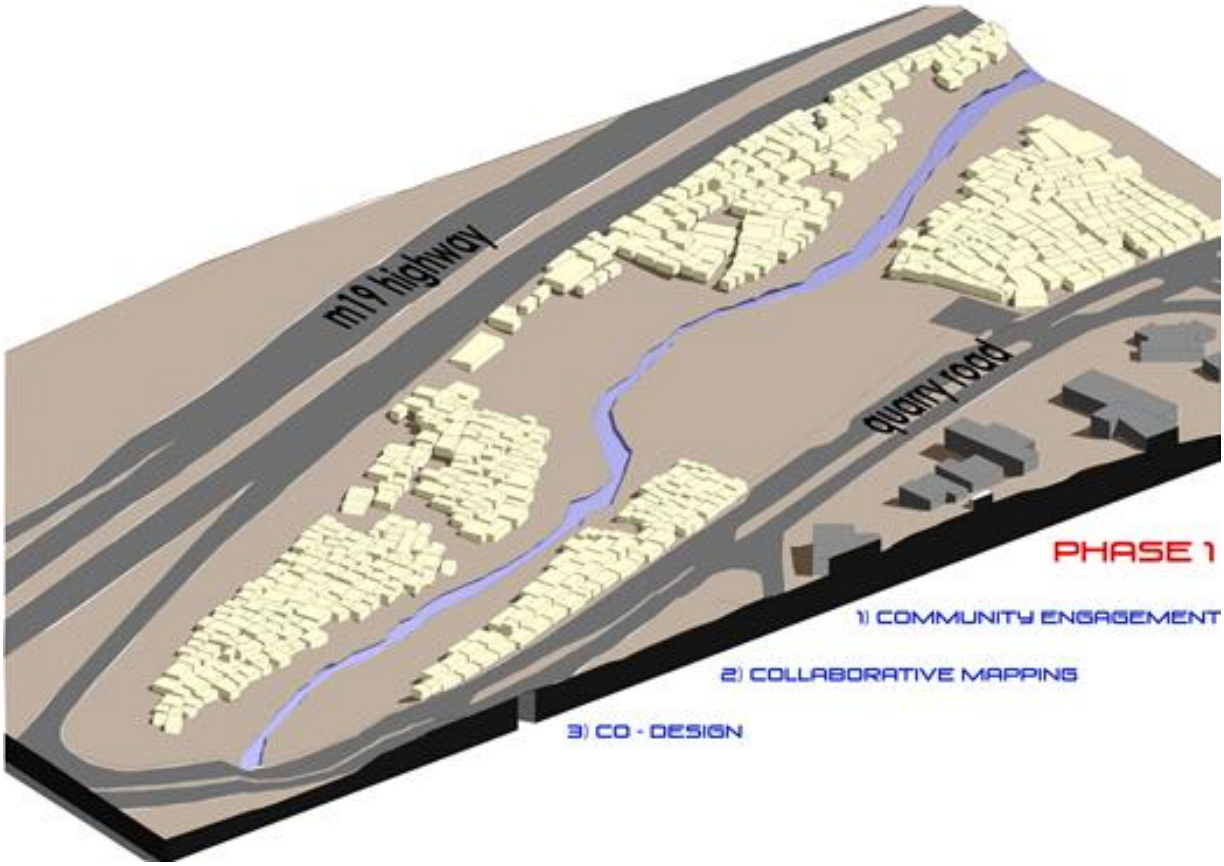

Figure 16 Phase 1 of Design Intervention

b) Phase 2

In phase 2, the construction of the Resilience Pods was designed as bridges along the river to link up the settlements (see Figure 17). These six buildings contain communal ablutions for males and females and water collection points. Each pod features a tower that lights up at night as a beacon for better visibility within the settlement. These towers contain water storage for rainwater and river water, along with necessary purification units and equipment to make the water safe. Shower water is discharged into grow beds for purification before being disposed of. The towers also house bat boxes and owl houses to address the settlement's serious problem of vermin and rats. The Resilience Pods also include waste collection points from which the settlement’s existing waste collection volunteers can sort and transport the waste to points where the municipality collects the waste and material to support wastepreneurship.

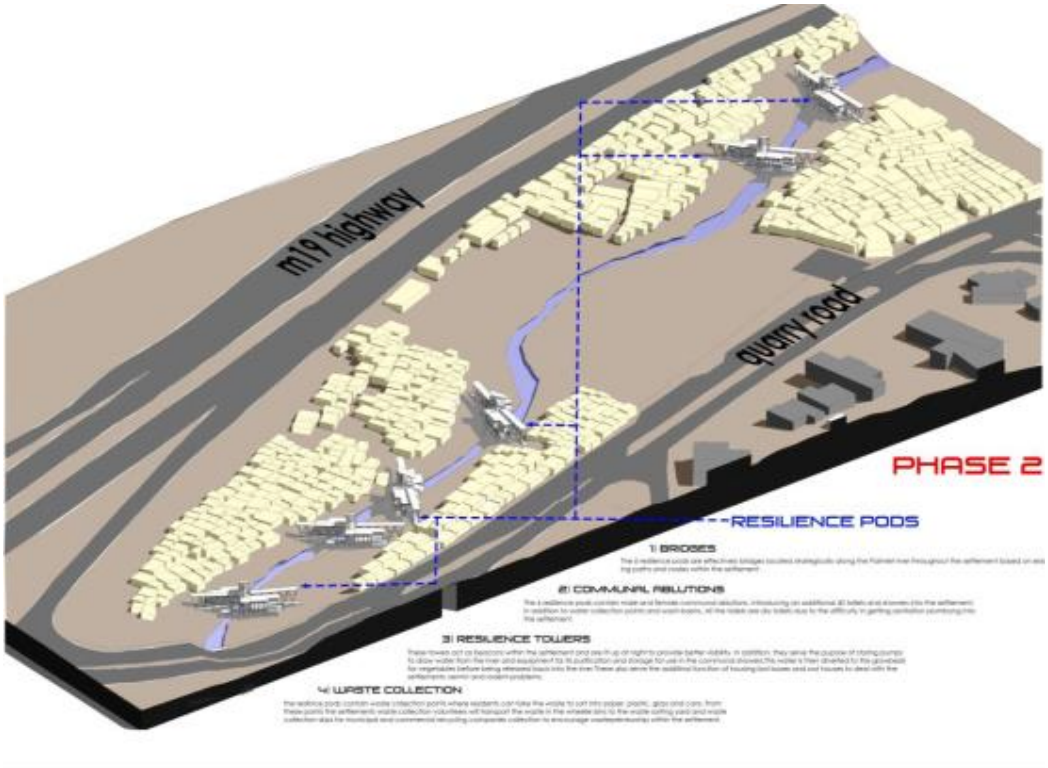

Figure 17 Phase 2 of Design Intervention

c) Phase 3

Construction of the first part of the Resilience Hub. Starting with Transitional Accommodation to facilitate re-blocking of vulnerable dwellings. This phase would also include "Community Flex-scape" in the form of 5 community rooms for creches, adult education, skills training, club rooms, and a range of activities that the community could decide upon (see Figure 18).

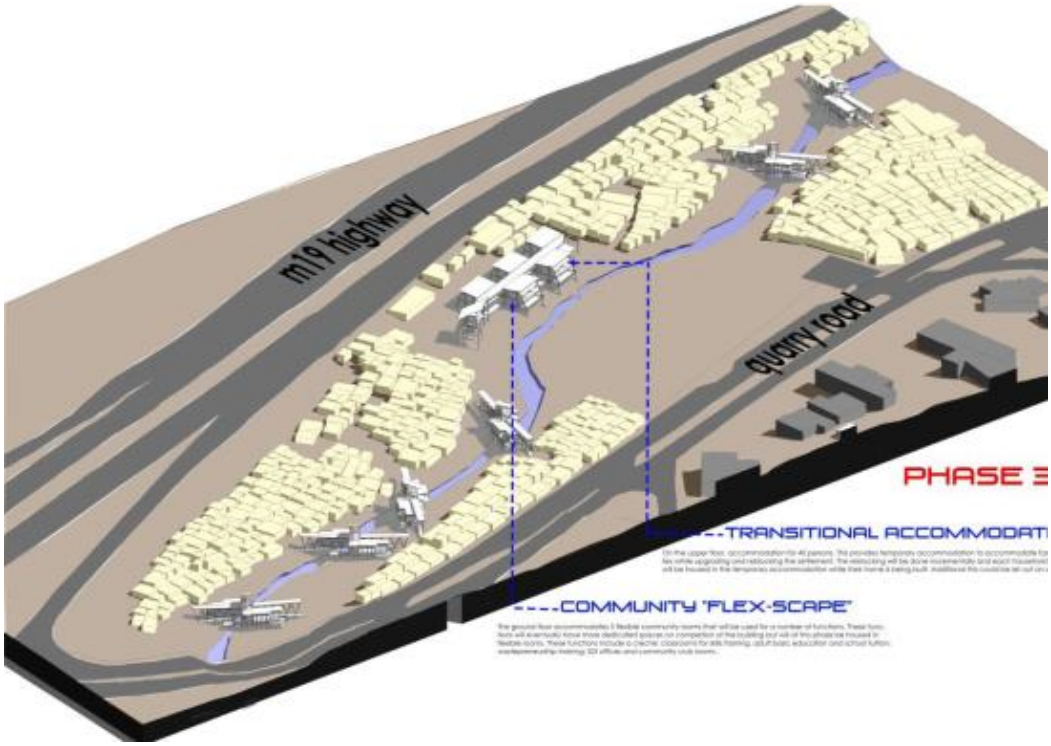

Figure 18 Phase 3 of Design Intervention

d) Phase 4

In phase 4, the construction of the Market Bridge provides a space where the community can sell their fresh produce on dedicated market days (see Figure 19). Workshops and trade spaces are established to produce and sell wares resulting from wastepreneurship initiatives. The beginning of reblocking initiatives is initiated to reorganize and improve the settlement layout for better functionality and infrastructure.

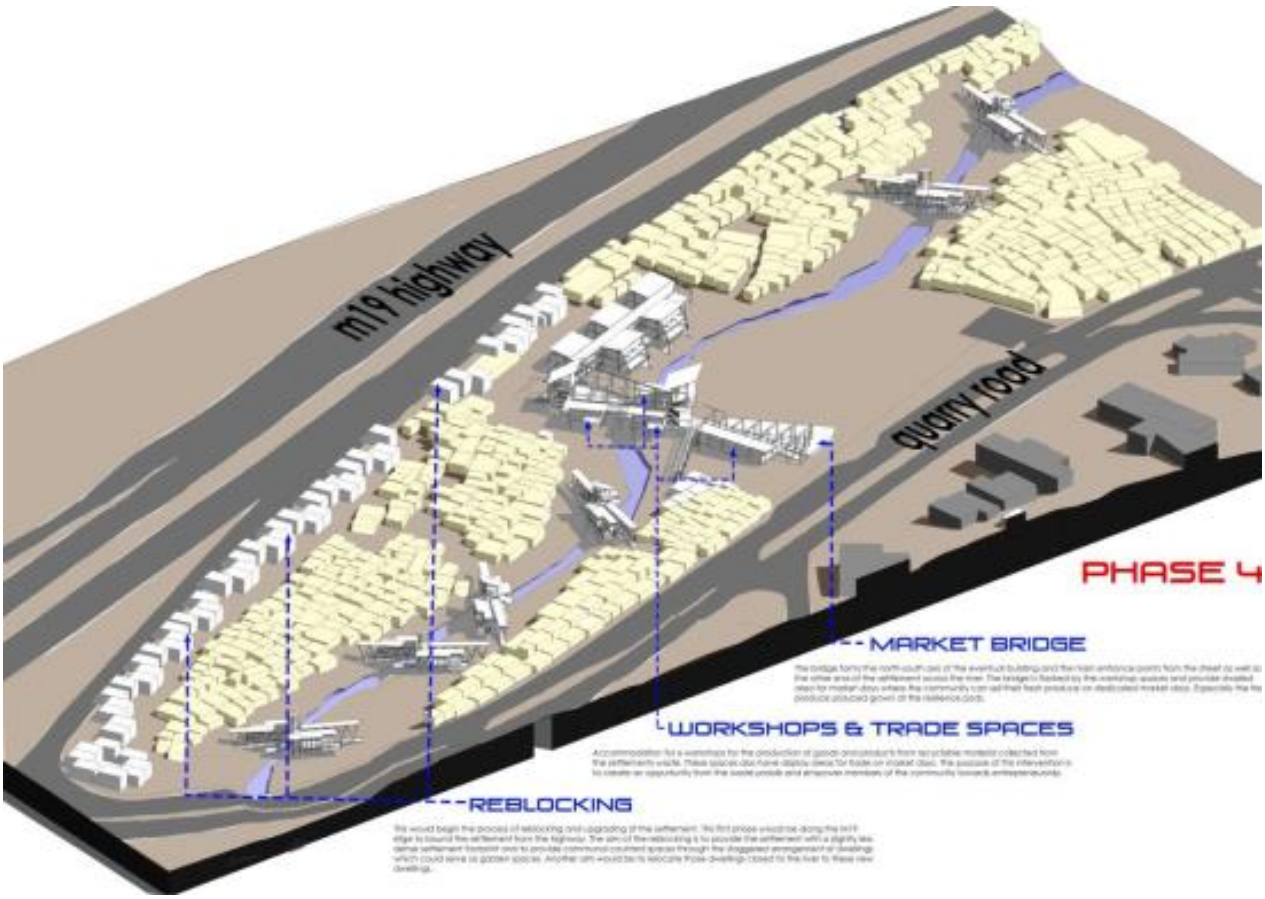

Figure 19 Phase 4 of Design Intervention

e) Phase 5

In Phase 5, the activities include constructing a library and constructing dedicated classrooms for tuition, adult education, and creches (see Figure 20).

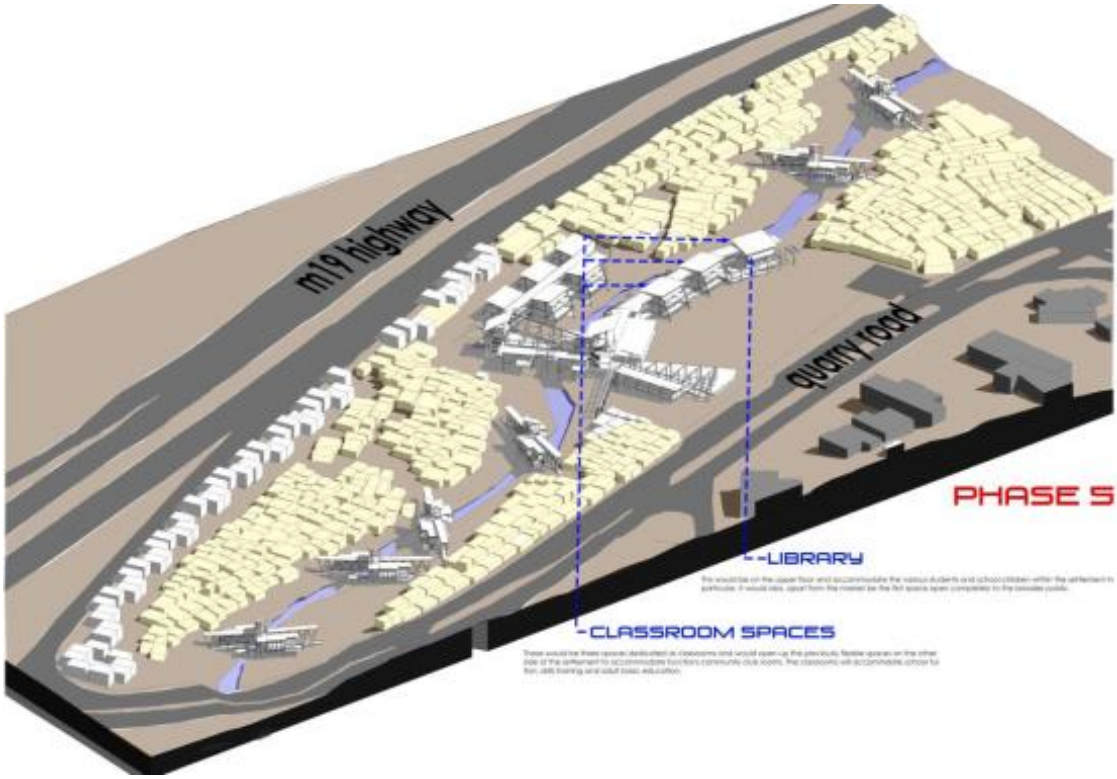

Figure 20 Phase 5 of Design Intervention

f) Phase 6

In Phase 6, the activities include the construction of a community hall, trade spaces, and further reblocking (see Figure 21 and Figure 22).

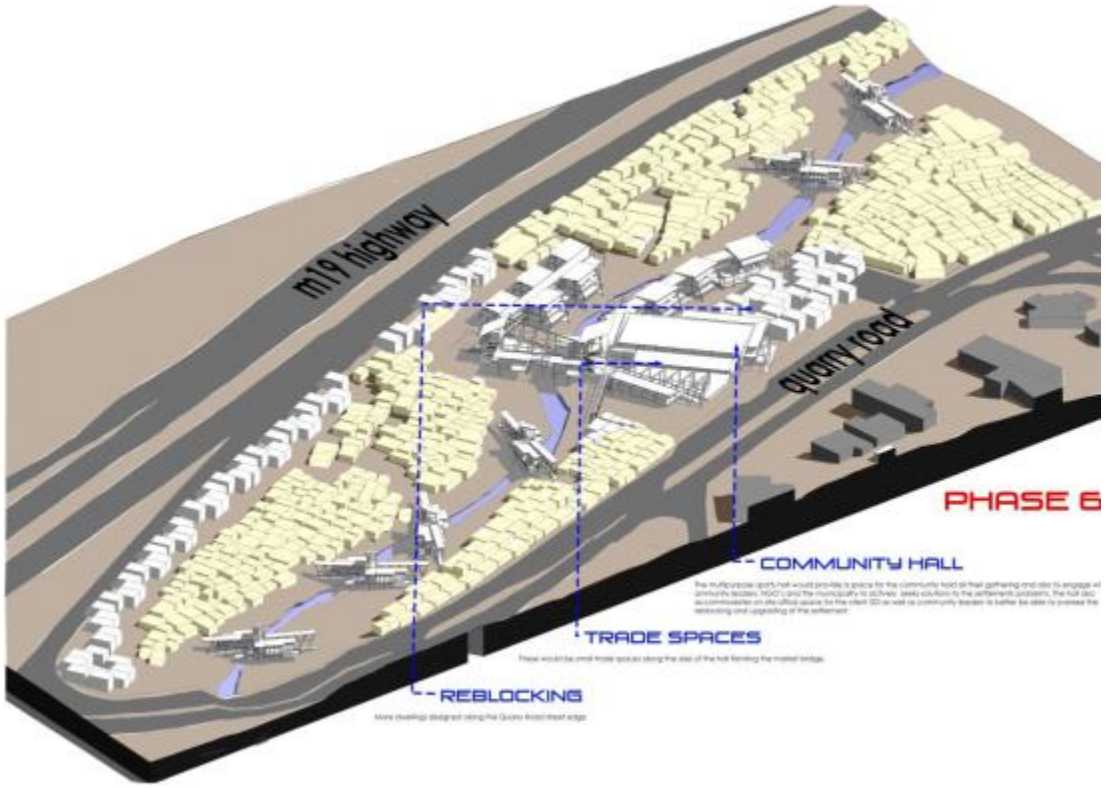

Figure 21 Phase 6 of Design Intervention

Figure 22 Pictorial View of Resilience Hub

5. CONCLUSION

The paper hypothesized that synthesizing architecture and informality, grounded in understanding socio-spatial dynamics, culture, economic networks, insurgent practices, and built environment production in informal settlements, can yield a more responsive architecture, enhancing resilience and improving quality of life. Literature underscores that this synthesized response should leverage existing knowledge systems within informal communities' daily lives. To address this context, architects must utilize various actions such as networking, research, mapping, design, and construction. Community collaborative mapping and Transect walks enable community empowerment and engagement, facilitating a bottom-up, community-driven architectural approach. The conceptualized architectural design aims to fortify community resilience to site-specific challenges, embodying an integrated and contextually sensitive architectural language and spatial quality.

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